index material, in which the above-described dispersion resin having a specific structure is contained together with an inorganic fine particle.

Related Art

Patent Document

[0003]

Patent Document 1: JP-A-2009-179678 (the term "JP-A" as used herein means an "unexamined published Japanese patent application")

Patent Document 2: JP-A-2008-185683

Patent Document 3: JP-A-2007-277514

Patent Document 4: JP-A-2008-239923

Summary ~~of the Invention~~

Problems that the ~~Invention~~ disclosure is to Solve

[0004]

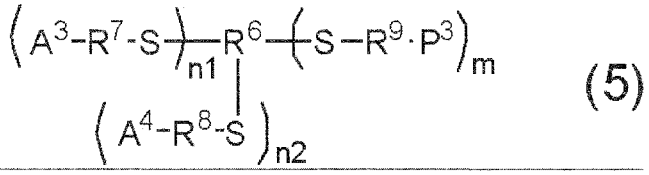
However, the above-described composition for the formation of a high-refractive-index material is required to contain an inorganic fine particle at a high content for achieving a high refractive index. In a composition containing an inorganic fine particle at a high content, dispersibility is bad due to aggregation, etc. of the inorganic fine particle, and the viscosity may be increased to obstruct the formation of a coated film. The problem to be solved is to develop a dispersant ensuring good dispersibility of an inorganic fine particle even at a high content and enabling decrease in the viscosity of a composition.

[0005]

The present ~~invention~~ disclosure has been made by taking into account the above-described problem, and an object of the present ~~invention~~ disclosure is to provide a dispersion composition having a high refractive index and a low viscosity, and a curable composition, a transparent film, a microlens and a solid-state imaging device each using the dispersion composition.

Another object of the present ~~invention~~ disclosure is to provide a compound able to afford a dispersion composition having a high refractive index and giving an excellent surface state to a film after coating and drying and maintain the dispersion stability of particles.

In an aspect, there is provided a compound represented by the following formula (5):



(5)

in formula (5),

R^6 represents an (m+n1+n2)-valent linking group,

each of R^7 to R^9 independently represents a single bond or a divalent linking group selected from the group consisting of a chain saturated hydrocarbon group, a cyclic saturated hydrocarbon group, an aromatic group, an ester bond, an amide bond, an ether bond, a nitrogen atom and a carbonyl group, or a group formed by combining two or more thereof,

A^3 represents a monovalent substituent having at least one group selected from the group consisting of a carboxyl group, a sulfonic acid group, a phosphoric acid group, a phosphonic acid group and a phosphinic acid group,

A^4 represents a monovalent substituent different from A^3, and represents a monovalent substituent having at least one group selected from the group consisting of an acetylacetonate group, an amino group ($-NH_2$), a substituted imino group represented by $-NHR^8$ or $-NR^9R^{10}$ (wherein each of R^8, R^9 and R^{10} independently represents an alkyl group having a carbon number of 1 to 20, an aryl group having a carbon number of 6 or more, or an aralkyl group having a carbon number of 7 or more), a guanidyl group represented by the following formula (a1), and an amidinyl group represented by the following formula (a2), a group having a phenol structure, a group represented by $-NR^{15}CONR^{16}R^{17}$ (wherein each of R^{15}, R^{16} and R^{17} independently represents a hydrogen atom, an alkyl group having a carbon number of 1 to 20, an aryl group having a carbon number of 6 or more, or an aralkyl group having a carbon number of 7), a group represented by $-NHCOOR^{18}$, $-NR^{19}COOR^{20}$, $-OCONHR^{21}$, or $-OCONR^{22}R^{23}$ (wherein each of R^{18}, R^{19}, R^{20}, R^{21}, R^{22} and R^{23} independently represents an alkyl group having a carbon number of 1 to 20, an aryl group having a carbon number of 6 or more, or an aralkyl group having a carbon number of 7 or more), an alkyl group, an aryl group, an alkyloxycarbonyl group, an alkylaminocarbonyl group, an

alkyleneoxy chain-containing group, a group having succinimide structure, phthalimide structure, or naphthalimide structure, a carboxyl group wherein a hydrogen atom is substituted with a counter ion, an aminosulfonyl group, a hydroxyl group, and a heterocyclic group.

n1 number of A^3 or R^7 may be the same or different from each other, n2 number of A^4 or R^8 may be the same or different from each other.

m represents a positive number of 8 or less.

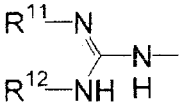
n1 represents from 1 to 8.

n2 represents from 1 to 8.

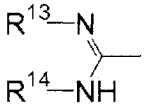
m+n1+n2 satisfies the range of 3 to 10.

P^3 represents a polymer chain derived from at least one member selected from a polymer or copolymer of a vinyl monomer, an ester-based polymer, an ether-based polymer, a urethane-based polymer, an amide-based polymer, an epoxy-based polymer, a silicone-based polymer, and a copolymer thereof.

and m number of P^3 or R^9 may be the same or different from each other:



(a1)



(a2)

in formula (a1), each of R^{11} and R^{12} independently represents an alkyl group having a carbon number of 1 to 20, an aryl group having a carbon number of 6 or more, or an aralkyl group having a carbon number of 7 or more.

in formula (a2), each of R^{13} and R^{14} independently represents an alkyl group having a carbon number of 1 to 20, an aryl group having a carbon number of 6 or more, or an aralkyl group having a carbon number of 7 or more.

In another aspect, there is provided a dispersion composition containing:

(A) a metal oxide particle having a primary particle diameter of 1 nm to 100 nm,

(B) a dispersant, and

(C) a solvent:

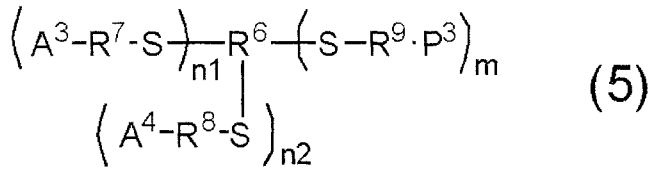
wherein the dispersant is a compound as claimed in any one of claims 1 to 10.

Means for Solving the Problems

[0006]

Claims

1. A compound represented by the following formula (5):



(5)

in formula (5),

R^6 represents an (m+n1+n2)-valent linking group,

each of R^7 to R^9 independently represents a single bond or a divalent linking group selected from the group consisting of a chain saturated hydrocarbon group, a cyclic saturated hydrocarbon group, an aromatic group, an ester bond, an amide bond, an ether bond, a nitrogen atom and a carbonyl group, or a group formed by combining two or more thereof,

A^3 represents a monovalent substituent having at least one group selected from the group consisting of a carboxyl group, a sulfonic acid group, a phosphoric acid group, a phosphonic acid group and a phosphinic acid group,

A^4 represents a monovalent substituent different from A^3, and represents a monovalent substituent having at least one group selected from the group consisting of an acetylacetonate group, an amino group ($-NH_2$), a substituted imino group represented by $-NHR^8$ or $-NR^9R^{10}$ (wherein each of R^8, R^9 and R^{10} independently represents an alkyl group having a carbon number of 1 to 20, an aryl group having a carbon number of 6 or more, or an aralkyl group having a carbon number of 7 or more), a guanidyl group represented by the following formula (a1), and an amidinyl group represented by the following formula (a2), a group having a phenol structure, a group represented by $-NR^{15}CONR^{16}R^{17}$ (wherein each of R^{15}, R^{16} and R^{17} independently represents a hydrogen atom, an alkyl group having a carbon number of 1 to 20, an aryl group having a carbon number of 6 or more, or an aralkyl group having a carbon number of 7), a group represented by $-NHCOOR^{18}$, $-NR^{19}COOR^{20}$, $-OCONHR^{21}$, or $-OCONR^{22}R^{23}$ (wherein each of R^{18}, R^{19}, R^{20}, R^{21}, R^{22} and R^{23} independently represents an alkyl group having a carbon number of 1 to 20, an aryl group having a carbon number of 6 or more, or an aralkyl group having a carbon number of 7 or more), an alkyl group, an aryl group, an alkyloxycarbonyl group, an alkylaminocarbonyl group, an

alkyleneoxy chain-containing group, a group having succinimide structure, phthalimide structure, or naphthalimide structure, a carboxyl group wherein a hydrogen atom is substituted with a counter ion, an aminosulfonyl group, a hydroxyl group, and a heterocyclic group,

n1 number of A^3 or R^7 may be the same or different from each other, n2 number of A^4 or R^8 may be the same or different from each other,

m represents a positive number of 8 or less,

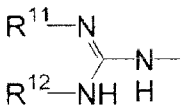
n1 represents from 1 to 8,

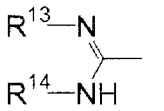
n2 represents from 1 to 8,

m+n1+n2 satisfies the range of 3 to 10,

P^3 represents a polymer chain derived from at least one member selected from a polymer or copolymer of a vinyl monomer, an ester-based polymer, an ether-based polymer, a urethane-based polymer, an amide-based polymer, an epoxy-based polymer, a silicone-based polymer, and a copolymer thereof,

and m number of P^3 or R^9 may be the same or different from each other:


(a 1)


(a 2)

in formula (a1), each of R^{11} and R^{12} independently represents an alkyl group having a carbon number of 1 to 20, an aryl group having a carbon number of 6 or more, or an aralkyl group having a carbon number of 7 or more,

in formula (a2), each of R^{13} and R^{14} independently represents an alkyl group having a carbon number of 1 to 20, an aryl group having a carbon number of 6 or more, or an aralkyl group having a carbon number of 7 or more.

2. The compound as claimed in claim 1,

wherein the substituent A^3 is a monovalent substituent having at least one acid group with a pKa of less than 5, and

the substituent A^4 is a monovalent substituent having at least one functional group with a pKa of 5 or more.

3. The polymer compound as claimed in claim 1 or 2,

wherein the substituent A^3 is a carboxyl group, a sulfonic acid group, a phosphoric acid group, or a phosphonic acid group,

and the substituent A^4 is a monovalent substituent having at least one group selected from the group consisting of an acetylacetonate group, a group having a phenol structure, a group represented by $-NR^{15}CONR^{16}R^{17}$ (wherein each of R^{15}, R^{16} and R^{17} independently represents a hydrogen atom, an alkyl group having a carbon number of 1 to 20, an aryl group having a carbon number of 6 or more, or an aralkyl group having a carbon number of 7), a group represented by $-NHCOOR^{18}$, $-NR^{19}COOR^{20}$, $-OCONHR^{21}$, or $-OCONR^{22}R^{23}$ (wherein each of R^{18}, R^{19}, R^{20}, R^{21}, R^{22} and R^{23} independently represents an alkyl group having a carbon number of 1 to 20, an aryl group having a carbon number of 6 or more, or an aralkyl group having a carbon number of 7 or more), an alkyl group, an aryl group, an alkyloxycarbonyl group, an alkylaminocarbonyl group, an alkyleneoxy chain-containing group, a group having succinimide structure, phthalimide structure, or naphthalimide structure, a carboxyl group wherein a hydrogen atom is substituted with a counter ion, an aminosulfonyl group, and a hydroxyl group.

4. The compound as claimed in any one of claims 1 to 3,
wherein the substituent A^3 is a carboxyl group.

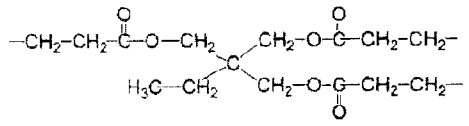
5. The compound as claimed in any one of claims 1 to 4,
wherein the substituent A^4 is an alkyl group, an aryl group, an acetylacetonate group, a group represented by $-NR^{15}CONR^{16}R^{17}$ (wherein each of R^{15}, R^{16} and R^{17} independently represents a hydrogen atom, an alkyl group having a carbon number of 1 to 20, an aryl group having a carbon number of 6 or more, or an aralkyl group having a carbon number of 7), a group represented by $-NHCOOR^{18}$, $-NR^{19}COOR^{20}$, $-OCONHR^{21}$, or $-OCONR^{22}R^{23}$ (wherein each of R^{18}, R^{19}, R^{20}, R^{21}, R^{22} and R^{23} independently represents an alkyl group having a carbon number of 1 to 20, an aryl group having a carbon number of 6 or more, or an aralkyl group having a carbon number of 7 or more).

6. The compound as claimed in claim 5,
wherein the substituent A^4 is an alkyl group.

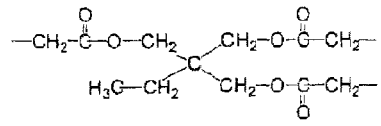
7. The compound as claimed in any one of claims 1 to 6,
wherein the polymer chain represented by P^3 contains at least one repeating unit and the repetition number k of the at least one repeating unit is from 3 to 50.

8. The compound as claimed in any one of claims 1 to 7,

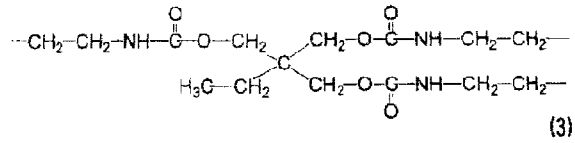
wherein R^6 in formula (5) is a group represented by any one of the following formulae (1) to (17).



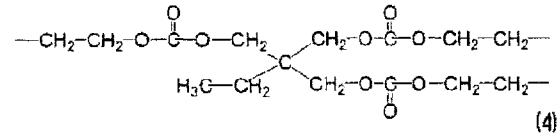
(1)



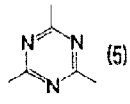
(2)



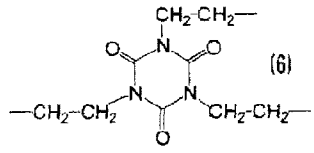
(3)



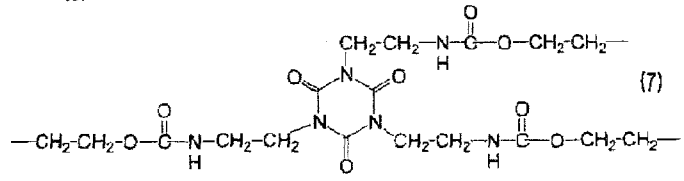
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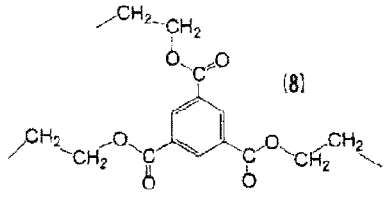
(5)



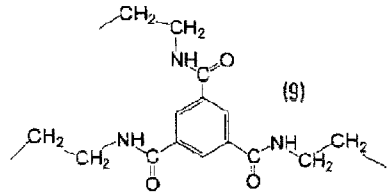
(6)



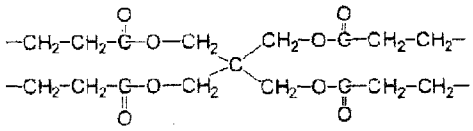
(7)



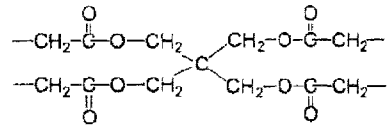
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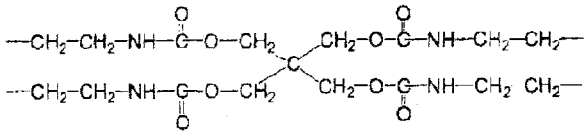
(9)



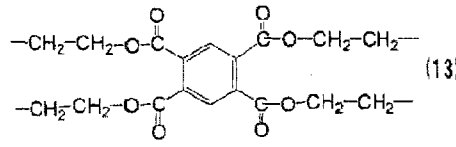
(10)



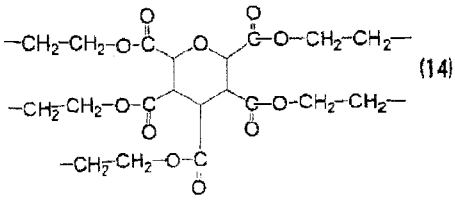
(11)



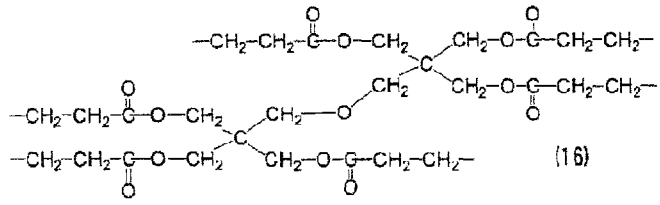
(12)



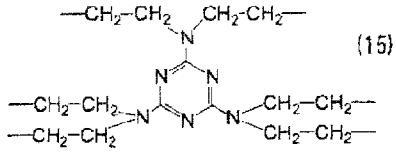
(13)



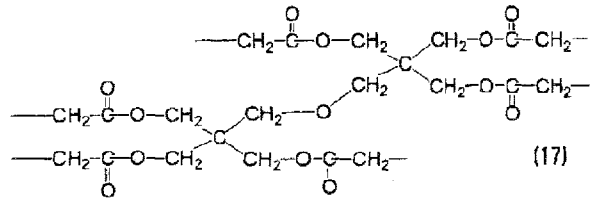
(14)



(16)



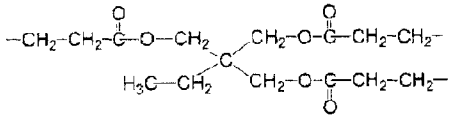
(15)



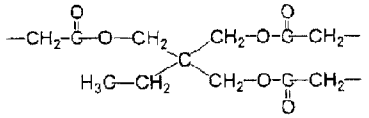
(17)

9. The compound as claimed in claim 8,

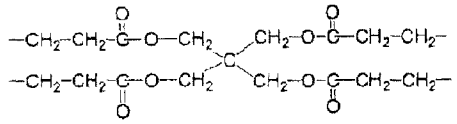
wherein R^6 in formula (5) is a group represented by any one of the following formulae (1), (2), (10), (11), (16) and (17).



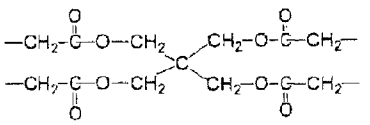
(1)



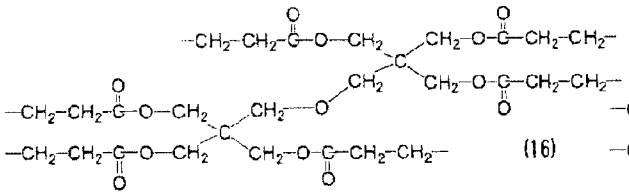
(2)



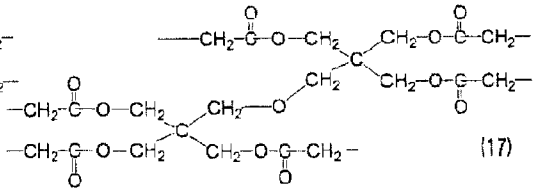
(10)



(11)



(16)



(17)

10. The compound as claimed in any one of claims 1 to 9,

wherein the weight average molecular weight is 10,000 or less.

11. A dispersion composition containing:

(A) a metal oxide particle having a primary particle diameter of 1 nm to 100 nm,

(B) a dispersant, and

(C) a solvent:

wherein the dispersant is a compound as claimed in any one of claims 1 to 10.

12. The dispersion composition as claimed in claim 11,

wherein the metal oxide particle is a colorless, white or transparent inorganic particle.

13. The dispersion composition as claimed in claim 11,

wherein the metal oxide particle is a titanium dioxide particle, a zirconium dioxide particle or a silicon dioxide particle.

14. The dispersion composition as claimed in any one of claims 11 to 13,

wherein the content of the compound represented by the formula (5) is from 5 to 40

mass% based on the total solid content of the dispersion composition.

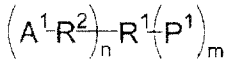
CLAIMS

1. A dispersion composition containing:

(A) a metal oxide particle having a primary particle diameter of 1 nm to 100 nm,

(B) a polymer compound represented by the following formula (1) having a weight average molecular weight of 5,000 to 8,000 and an acid value of 70 to 90 mgKOH/g, and

(C) a solvent:

 formula (1)

in formula (1),

R^1 represents an (m+n)-valent linking group represented by any one of the following formulae (1) to (17),

R^2 represents a single bond or a divalent linking group,

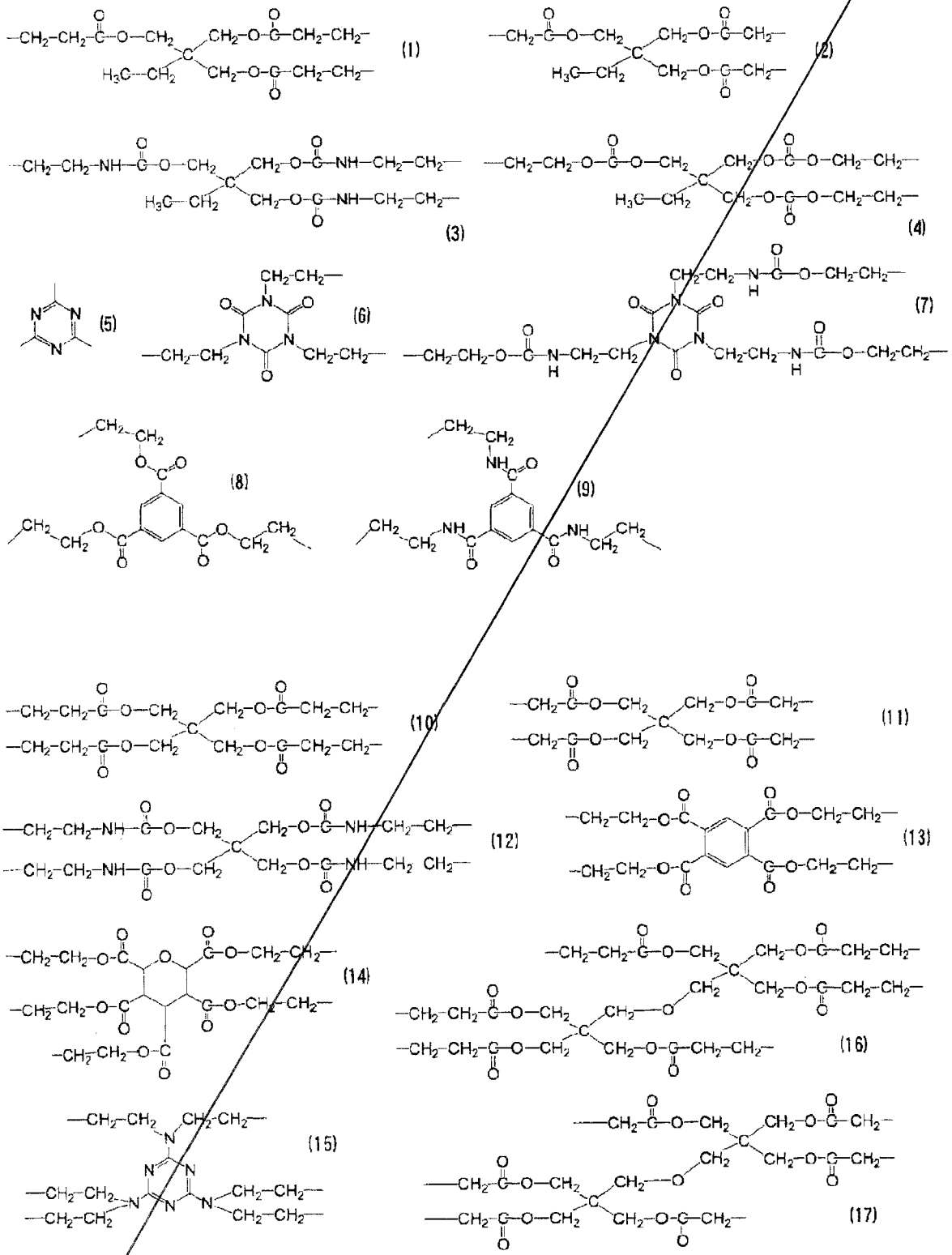
A^1 represents a monovalent substituent having at least one group selected from the group consisting of an acid group, a urea group, a urethane group, a coordinating oxygen atom-containing group, a basic nitrogen atom-containing group, a phenol group, an alkyl group, an aryl group, an alkyleneoxy chain-containing group, an imide group, an alkyloxycarbonyl group, an alkylaminocarbonyl group, a carboxylate group, a sulfonamide group, a heterocyclic group, an alkoxysilyl group, an epoxy group, an isocyanate group and a hydroxyl group, n number of A^1 or R^2 may be the same or different from each other,

m represents a positive number of 8 or less,

n represents from 1 to 9,

m+n satisfies the range of 3 to 10,

P^1 represents a polymer chain, and m number of P^1 may be the same or different from each other:



2. The dispersion composition as claimed in claim 1,

wherein the metal oxide particle (A) is a particle surface-treated with an organic compound.

3. The dispersion composition as claimed in claim 2,

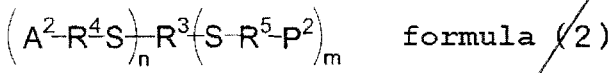
wherein the organic compound is a fatty acid.

4. The dispersion composition as claimed in any one of claims 1 to 3,

wherein the content of the metal oxide particle (A) is 65 mass% or more based on the total solid content of the dispersion composition.

5. The dispersion composition as claimed in any one of claims 1 to 4,

wherein the polymer compound (B) is a polymer compound represented by the following formula (2):



formula (2)

in formula (2),

R^3 represents an (m+n)-valent linking group represented by any one of the following formulae (1) to (17),

each of R^4 and R^5 independently represents a single bond or a divalent linking group,

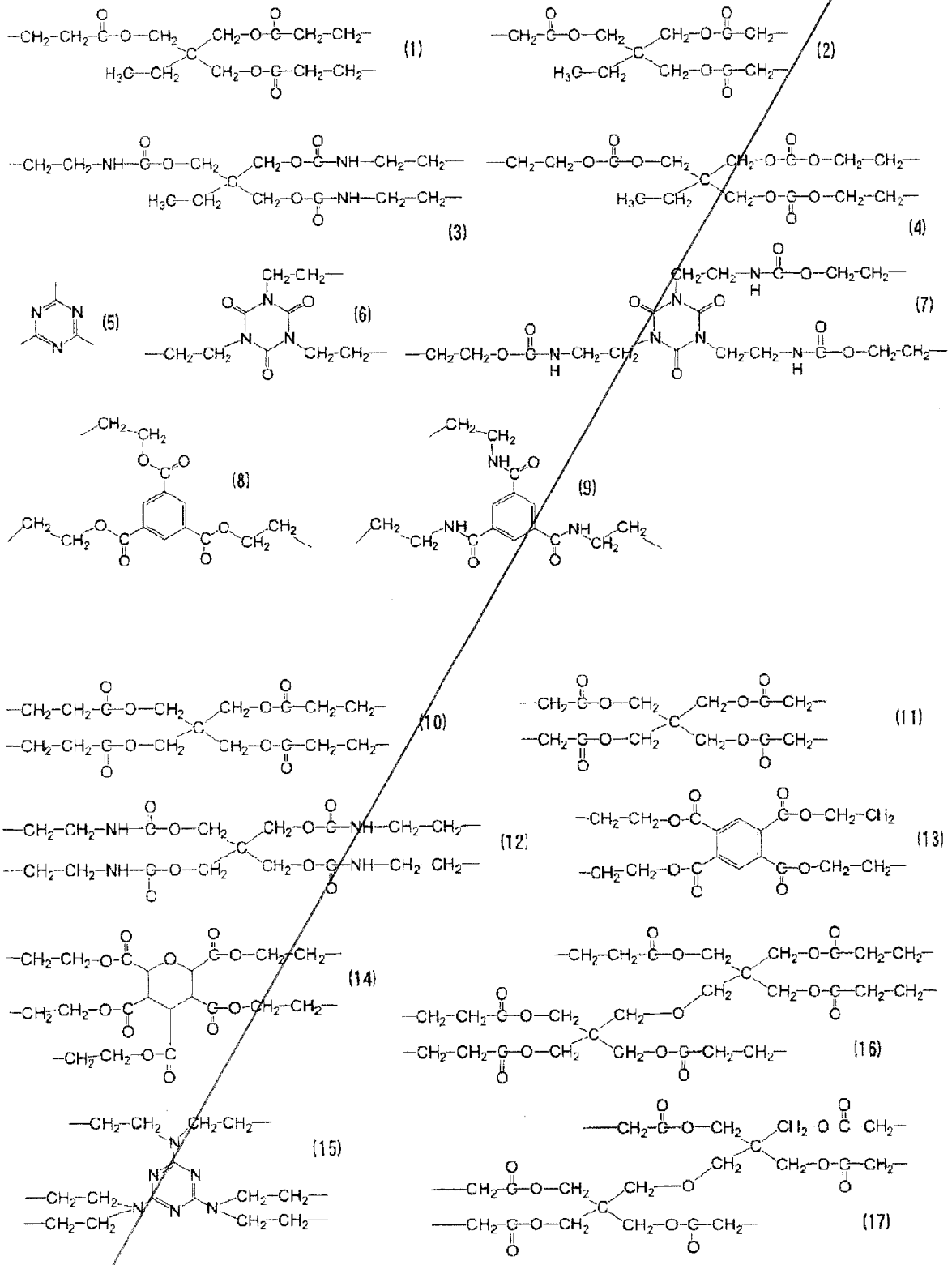
A^2 represents a monovalent substituent having at least one group selected from the group consisting of an acid group, a urea group, a urethane group, a coordinating oxygen atom-containing group, a basic nitrogen atom-containing group, a phenol group, an alkyl group, an aryl group, an alkyleneoxy chain-containing group, an imide group, an alkyloxycarbonyl group, an alkylaminocarbonyl group, a carboxylate group, a sulfonamide group, a heterocyclic group, an alkoxysilyl group, an epoxy group, an isocyanate group and a hydroxyl group, n number of A^2 or R^4 may be the same or different from each other,

m represents a positive number of 8 or less,

n represents from 1 to 9,

m+n satisfies the range of 3 to 10,

P^2 represents a polymer chain, and m number of P^2 or R^5 may be the same or different from each other:



6. The dispersion composition as claimed in any one of claims 1 to 5,

wherein A^1 in formula (1) or A^2 in formula (2) is a monovalent substituent having at least one group selected from the group consisting of an acid group, a phenol group, an alkyl

group, an aryl group, an alkyleneoxy chain-containing group, a hydroxyl group, a urea group, a urethane group, a sulfonamide group, an imide group and a coordinating oxygen atom-containing group.

7. The dispersion composition as claimed in any one of claims 1 to 5,

wherein A^1 in formula (1) or A^2 in formula (2) is a monovalent substituent having at least one functional group with a pKa of 5 or more.

8. The dispersion composition as claimed in claim 7,

wherein the functional group with a pKa of 5 or more is a coordinating oxygen atom-containing group, a basic nitrogen atom-containing group, a phenol group, a urea group, a urethane group, an alkyl group, an aryl group, an alkyloxycarbonyl group, an alkylaminocarbonyl group, an alkyleneoxy chain-containing group, an imide group, a carboxylate group, a sulfonamide group, a hydroxyl group or a heterocyclic group.

9. The dispersion composition as claimed in any one of claims 1 to 8,

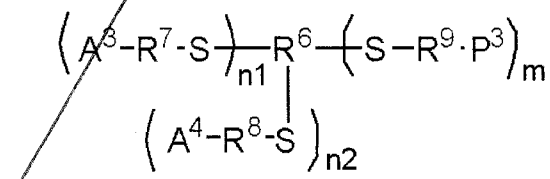
wherein the polymer chain represented by P^1 or P^2 is a polymer chain derived from at least one member selected from a polymer or copolymer of a vinyl monomer, an ester-based polymer, an ether-based polymer, a urethane-based polymer, an amide-based polymer, an epoxy-based polymer, a silicone-based polymer, and a modification product or copolymer thereof.

10. The dispersion composition as claimed in any one of claims 1 to 9,

wherein the polymer chain represented by P^1 or P^2 contains at least one repeating unit and the repetition number k of the at least one repeating unit is from 3 to 50.

11. The dispersion composition as claimed in any one of claims 1 to 10,

wherein the polymer compound (B) is a polymer compound represented by the following formula (5):



(5)

in formula (5),

R^6 represents an (m+n1+n2)-valent linking group represented by any one of the following formulae (1) to (17),

each of R^7 to R^9 independently represents a single bond or a divalent linking group,

A^3 represents a monovalent substituent having at least one acid group,

A^4 represents a monovalent substituent different from A^3, n1 number of A^3 or R^7 may be the same or different from each other, n2 number of A^4 or R^8 may be the same or different from each other,

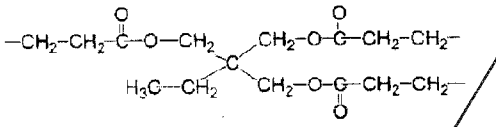
m represents a positive number of 8 or less,

n1 represents from 1 to 8,

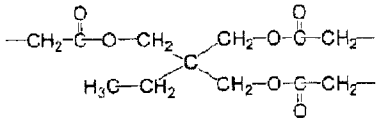
n2 represents from 1 to 8,

m+n1+n2 satisfies the range of 3 to 10,

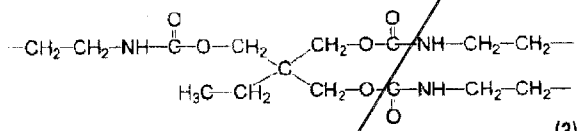
P^3 represents a polymer chain, and m number of P^3 or R^9 may be the same or different from each other:



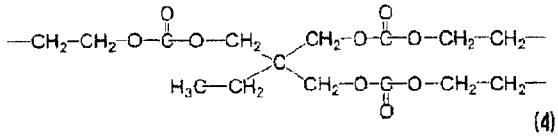
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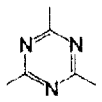
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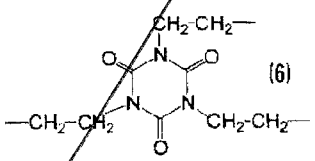
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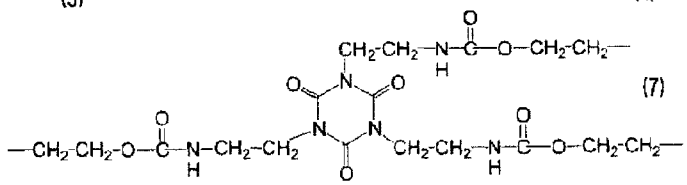
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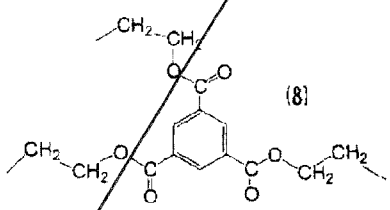
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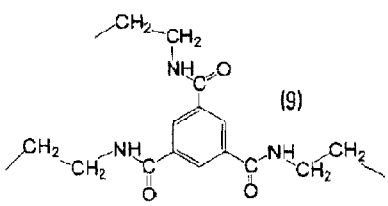
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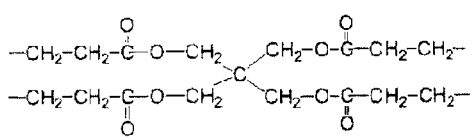
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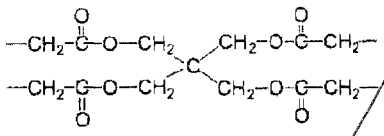
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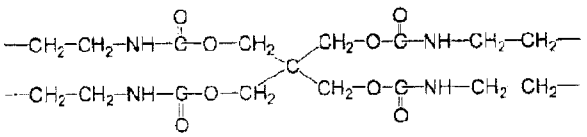
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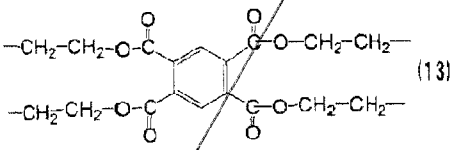
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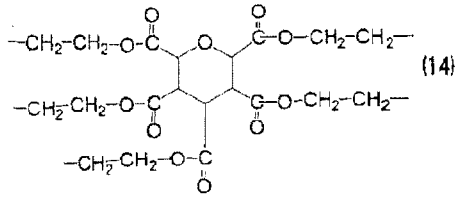
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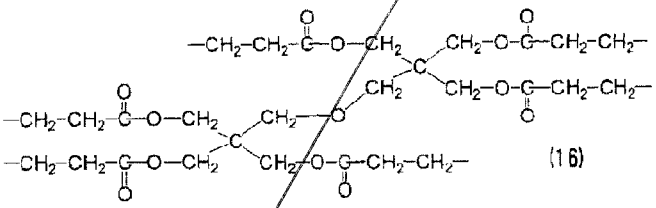
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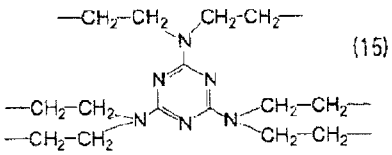
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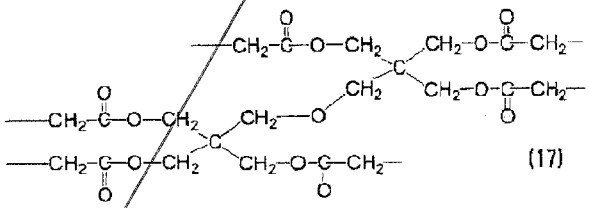
(14)



(16)



(15)



(17)

12. A curable composition containing:
the dispersion composition claimed in any one of claims 1 to 11 and
(D) a polymerizable compound.

13. The curable composition as claimed in claim 12,
wherein the polymerizable compound (D) is at least one member selected from the group consisting of a compound having two or more epoxy groups or oxetanyl groups in the molecule and a compound having two or more terminal ethylenically unsaturated bonds.

14. The curable composition as claimed in claim 12 or 13, further containing at least one member selected from the group consisting of (E) a polymerization initiator and a binder polymer.

15. The curable composition as claimed in claim 14,
wherein the polymerization initiator (E) is an oxime-based polymerization initiator.

16. The curable composition as claimed in any one of claims 12 to 15, which is used for the formation of a microlens or for the formation of an undercoat film of a color filter.

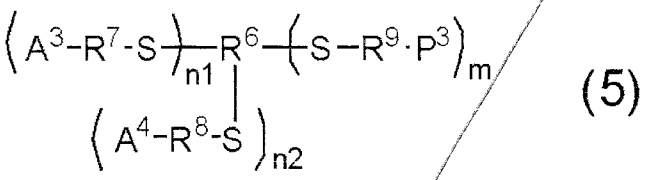
17. A transparent film formed using the curable composition claimed in any one of claims 12 to 16.

18. A microlens formed using a transparent film obtained from the curable composition claimed in claim 16.

19. A solid-state imaging device having the microlens claimed in claim 18.

20. A method for producing the dispersion composition claimed in any one of claims 1 to 11.

21. A polymer compound represented by the following formula (5):



(5)

in formula (5),

R^6 represents an (m+n1+n2)-valent linking group represented by any one of the following formulae (1) to (17),

each of R^7 to R^9 independently represents a single bond or a divalent linking group,

A^3 represents a monovalent substituent having at least one acid group with a pKa of less than 5,

A^4 represents a monovalent substituent different from A^3 and having at least one functional group with a pKa of 5 or more, n1 number of A^3 or R^7 may be the same or different from each other, n2 number of A^4 or R^8 may be the same or different from each other,

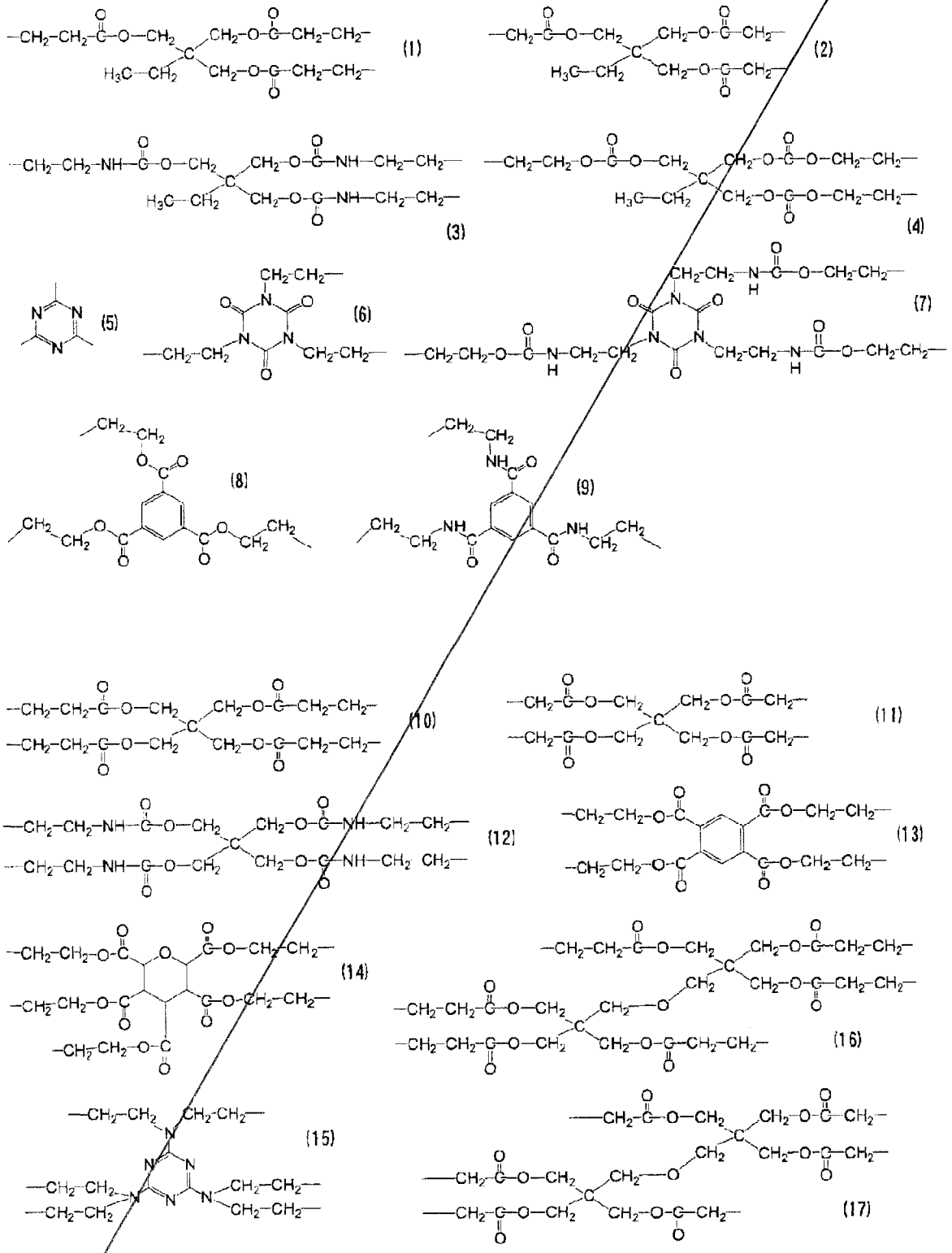
m represents a positive number of 8 or less,

n1 represents from 1 to 8,

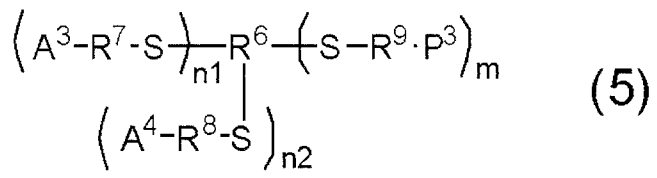
n2 represents from 1 to 8,

m+n1+n2 satisfies the range of 3 to 10,

P^3 represents a polymer chain, and m number of P^3 or R^9 may be the same or different from each other:



22. A polymer compound represented by the following formula (5) having a weight average molecular weight of 5,000 to 8,000 and an acid value of 70 to 90 mgKOH/g:



(5)

in formula (5),

R^6 represents an (m+n1+n2)-valent linking group represented by any one of the following formulae (1) to (17),

each of R^7 to R^9 independently represents a single bond or a divalent linking group,

A^3 represents a monovalent substituent having at least one acid group,

A^4 represents a monovalent substituent different from A^3, n1 number of A^3 or R^7 may be the same or different from each other, n2 number of A^4 or R^8 may be the same or different from each other,

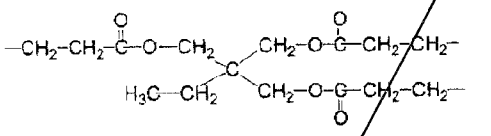
m represents a positive number of 8 or less,

n1 represents from 1 to 8,

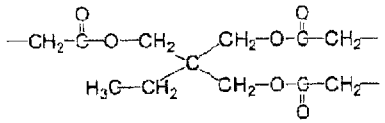
n2 represents from 1 to 8,

m+n1+n2 satisfies the range of 3 to 10,

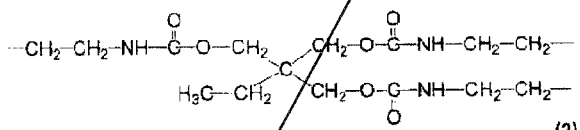
P^3 represents a polymer chain, and m number of P^3 or R^9 may be the same or different from each other:



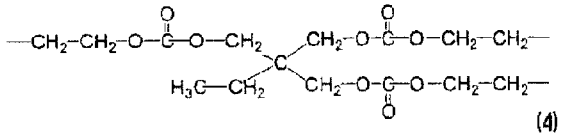
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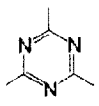
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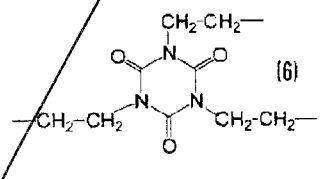
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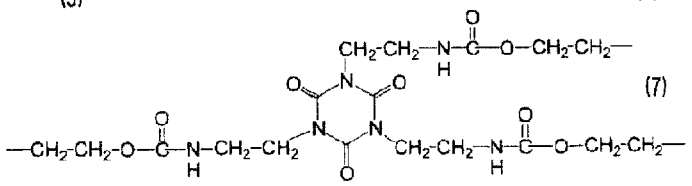
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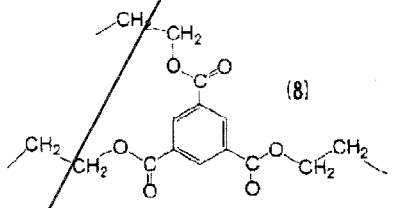
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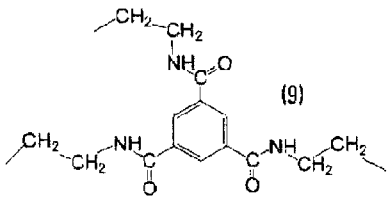
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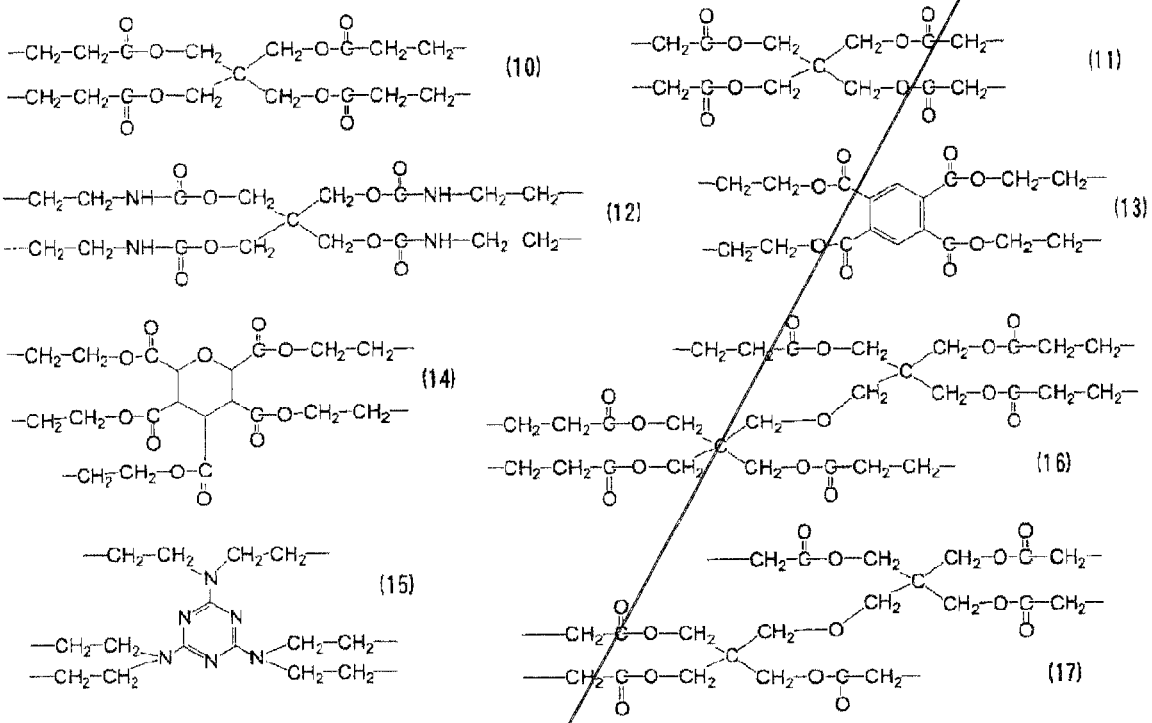
(7)



(8)



(9)



23. The polymer compound as claimed in claim 22,

wherein the substituent A^3 is a monovalent substituent having at least one acid group with a pKa of less than 5, and

the substituent A^4 is a monovalent substituent having at least one functional group with a pKa of 5 or more.

24. The polymer compound as claimed in any one of claims 21 to 23,

wherein the substituent A^3 is a monovalent substituent having at least one group selected from the group consisting of a carboxylic acid group, a sulfonic acid group, a phosphoric acid group, a phosphonic acid group and a phosphinic acid group, and

the substituent A^4 different from A^3 is a monovalent substituent having at least one group selected from the group consisting of a coordinating oxygen atom-containing group, a basic nitrogen atom-containing group, a phenol group, a urea group, a urethane group, an alkyl group, an aryl group, an alkyloxycarbonyl group, an alkylaminocarbonyl group, an alkyleneoxy chain-containing group, an imide group, a carboxylate group, a sulfonamide group, a hydroxyl group and a heterocyclic group.

25. The polymer compound as claimed in any one of claims 21 to 24, wherein the substituent A^3 is a carboxylic acid group.

26. The polymer compound as claimed in any one of claims 21 to 25, wherein the substituent A^4 is an alkyl group, an aryl group, a coordinating oxygen atom-containing group, a urea group or a urethane group.

27. The polymer compound as claimed in any one of claims 21 to 26, wherein the polymer chain represented by P^3 is a polymer chain derived from at least one member selected from a polymer or copolymer of a vinyl monomer, an ester-based polymer, an ether-based polymer, a urethane-based polymer, an amide-based polymer, an epoxy-based polymer, a silicone-based polymer, and a modification product or copolymer thereof.

28. The polymer compound as claimed in any one of claims 21 to 27, wherein the polymer chain represented by P^3 contains at least one repeating unit and the repetition number k of said at least one repeating unit is from 3 to 50.

29. The polymer compound as claimed in claim 21, wherein the weight average molecular weight is 10,000 or less.