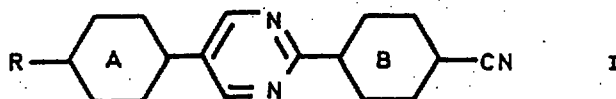


SPECIFICATION

Cyclohexyl-pyrimidine nitriles, useful in liquid crystal mixtures and display devices

5 The present invention is concerned with novel pyrimidine derivatives of the general formula

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I

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wherein at least one of the rings A and B represents a trans-1,4-disubstituted cyclohexane ring and the other is optionally aromatic and R represents a straight-chain alkyl or alkoxy group containing 1 to 10 carbon atoms or a branched-chain alkyl group of the formula $C_2H_5-CH(CH_3)-(CH_2)_n$ in which n stands for 1, 2 or 3.

15 The invention is also concerned with a process for the manufacture of the pyrimidine derivatives of formula I hereinbefore, nematic and cholesteric mixtures containing said pyrimidine derivatives and the use of said derivatives in electro-optical apparatuses.

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The invention is also concerned with a process for the manufacture of an electro-optical apparatus, which process comprises introducing one or more of the pyrimidine derivatives of formula I given above, if desired in admixture with other nematic and/or non-nematic compounds and/or one or more dichroic colouring substances into a suitable cell.

20

The pyrimidine derivatives of formula I are particularly valuable as components of liquid crystalline mixtures and, for the most part, they themselves possess liquid crystalline properties; the pyrimidine derivatives containing a straight side-chain forming a nematic meso phase and the optically active pyrimidine derivatives containing a branched side-chain forming a cholesteric meso phase. The present pyrimidine derivatives possess, inter alia, a very high positive anisotropy of the dielectric constants ($\epsilon_{||} > \epsilon_{\perp}$, $\epsilon_{||}$ signifying the dielectric constant along the longitudinal axis of the molecule and $\epsilon_{\perp}$ signifying the dielectric constant perpendicular thereto).

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In an electric field, the pyrimidine derivatives of formula I orientate themselves (because $\epsilon_{||} > \epsilon_{\perp}$) with the direction of their largest dielectric constant (i.e. with their longitudinal axes) parallel to the field direction. This effect is used, inter alia, in the interaction between embedded molecules and the liquid crystalline molecules (guest-host interaction) described by J. H. Heilmeyer and L. A. Zanoni [Applied Physics Letters 13, 91 (1968)]. A further interesting application of the dielectric field orientation exists in the rotation cell discovered by M. Schadt and W. Helfrich [Applied Physics Letters 18, (1971)] and in the Kerr cell described in Molecular Crystals and Liquid Crystals 17, 355 (1972).

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The electro-optical rotation cell is essentially a condenser having transparent electrodes, the dielectric of which is formed from a nematic crystal with $\epsilon_{||} > \epsilon_{\perp}$. The longitudinal molecular axes of the liquid crystals are arranged in twisted form between the condenser plates in the fieldless state, the twisting structure being determined by the given wall orientation of the molecules. Upon the application of an electric potential to the condenser plates, the molecules adjust themselves with their longitudinal axes in the field direction (i.e. perpendicular to the surface of the plates), by which means linear polarised light is no longer rotated in the dielectric (the liquid crystal is uniaxially perpendicular to the surface of the plates). This effect is reversible and can be used to electrically control the optical transmissivity of the condenser.

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In such a "light rotation cell", it is, inter alia, desirable to use compound or mixtures which possess a low threshold potential, this being important, for example, when a rotation cell is used in pocket calculators etc.

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Further, it is known that the addition of cholesteric substances to a matrix of nematic liquid crystals with positive anisotropy of the dielectric constants leads to a cholesteric mixture which undergoes a cholesteric-nematic phase transition by the application of an electric field. This phase transition is reversible and makes possible high switching times of electro-optical apparatuses which operate with such mixtures.

It has now been found in accordance with the present invention that the pyrimidine derivatives of formula I have a particularly large mesophase range with high clearing points and that, accordingly, they are particularly suitable for increasing the clearing points of nematic mixtures. In addition, they not only possess the required large positive anisotropy of the dielectric constants, and accordingly low threshold potentials, in indicating devices based on a field effect, for example the rotation cell described earlier, but they exhibit a short relay time and a high chemical stability. Furthermore, the pyrimidine derivatives of formula I considerably reduce, in indicating devices based on a field effect, the temperature dependence of the optical transmission curves when they are mixed with other liquid crystalline substances such as, for example, para-cyano-substituted Schiffs bases, esters or biphenyls. This property renders the pyrimidine derivatives of formula I particularly valuable for multiplex working in indicating devices having a low threshold potential. A further advantage of the present pyrimidine derivatives is that they are colourless. Mixtures which contain the pyrimidine derivatives of formula I are characterised by having a ready orientability and slight smectic tendencies and provide a high contrast in indicating devices.

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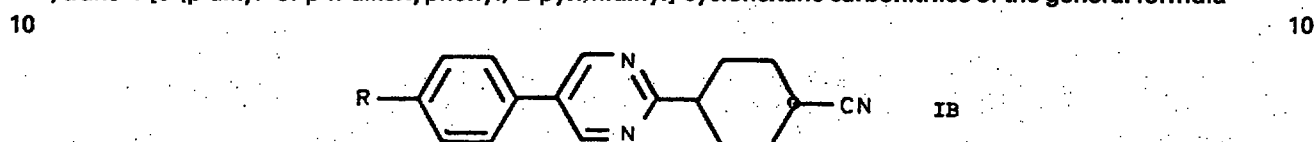
55 short relay time and a high chemical stability. Furthermore, the pyrimidine derivatives of formula I considerably reduce, in indicating devices based on a field effect, the temperature dependence of the optical transmission curves when they are mixed with other liquid crystalline substances such as, for example, para-cyano-substituted Schiffs bases, esters or biphenyls. This property renders the pyrimidine derivatives of formula I particularly valuable for multiplex working in indicating devices having a low threshold potential. A further advantage of the present pyrimidine derivatives is that they are colourless. Mixtures which contain the pyrimidine derivatives of formula I are characterised by having a ready orientability and slight smectic tendencies and provide a high contrast in indicating devices.

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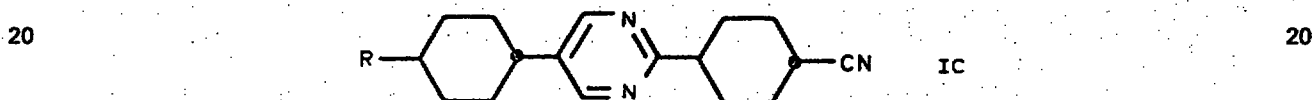
The pyrimidine derivatives falling within formula I hereinbefore are either trans-p-[5-(4-alkyl- or 4-n-alkoxy-cyclohexyl)-2-pyrimidinyl]benzonitriles of the general formula



, trans-4-[5-(p-alkyl- or p-n-alkoxyphenyl)-2-pyrimidinyl]-cyclohexane carbonitriles of the general formula



or trans-4-[5-(trans-4-alkyl- or trans-4-n-alkoxycyclo-hexyl)-2-pyrimidinyl]cyclohexane carbonitriles of the general formula



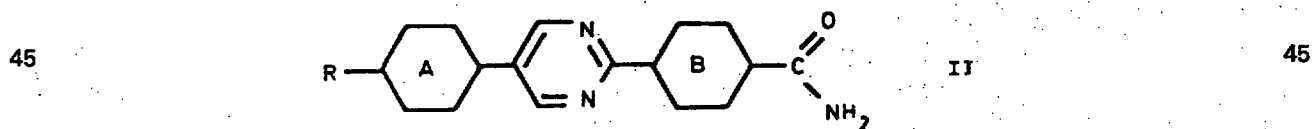
; in which formulae R has the significance given earlier.

25 Of the pyrimidine derivatives of formulae IA, IB and IC there are preferred those of formula IA and, especially, those of formula IA in which R represents an alkyl group. Where R represents an alkyl group there are preferred in all compounds of formulae IA, IB and IC those in which the alkyl group contains 2 to 8 carbon atoms, especially 2 to 7 carbon atoms. Where R represents an alkoxy group, there are preferred those alkoxy groups containing up to 6 carbon atoms.

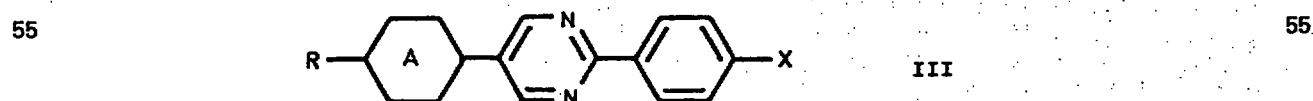
30 Examples of pyrimidine derivatives of formula I hereinbefore are:

- Trans-p-[5-(4-methylcyclohexyl)-2-pyrimidinyl]benzonitrile;
 trans-p-[5-(4-ethylcyclohexyl)-2-pyrimidinyl]benzonitrile;
 trans-p-[5-(4-propylcyclohexyl)-2-pyrimidinyl]benzonitrile;
 trans-p-[5-(4-butylcyclohexyl)-2-pyrimidinyl]benzonitrile;
 35 trans-p-[5-(4-pentylcyclohexyl)-2-pyrimidinyl]benzonitrile;
 trans-p-[5-(4-hexylcyclohexyl)-2-pyrimidinyl]benzonitrile;
 trans-p-[5-(4-heptylcyclohexyl)-2-pyrimidinyl]benzonitrile;
 trans-p-[5-(4-octylcyclohexyl)-2-pyrimidinyl]benzonitrile;
 trans-p-[5-(4-nonylcyclohexyl)-2-pyrimidinyl]benzonitrile;
 40 trans-p-[5-(4-decylcyclohexyl)-2-pyrimidinyl]benzonitrile;
 trans-p-[5-(4-methoxycyclohexyl)-2-pyrimidinyl]benzonitrile;
 trans-p-[5-(4-ethoxycyclohexyl)-2-pyrimidinyl]benzonitrile;
 trans-p-[5-(4-propyloxycyclohexyl)-2-pyrimidinyl]benzonitrile;
 trans-p-[5-(4-butyloxycyclohexyl)-2-pyrimidinyl]benzonitrile;
 45 trans-p-[5-(4-pentyloxycyclohexyl)-2-pyrimidinyl]benzonitrile;
 trans-p-[5-(4-hexyloxycyclohexyl)-2-pyrimidinyl]benzonitrile;
 trans-p-[5-(4-heptyloxycyclohexyl)-2-pyrimidinyl]benzonitrile;
 trans-p-[5-(4-octyloxycyclohexyl)-2-pyrimidinyl]benzonitrile;
 trans-p-[5-(4-nonyloxycyclohexyl)-2-pyrimidinyl]benzonitrile;
 50 trans-p-[5-(4-decylloxycyclohexyl)-2-pyrimidinyl]benzonitrile;
 trans-4-[5-(p-methylphenyl)-2-pyrimidinyl]cyclohexane carbonitrile;
 trans-4-[5-(p-ethylphenyl)-2-pyrimidinyl]cyclohexane carbonitrile;
 trans-4-[5-(p-propylphenyl)-2-pyrimidinyl]cyclohexane carbonitrile;
 trans-4-[5-(p-butylphenyl)-2-pyrimidinyl]cyclohexane carbonitrile;
 55 trans-4-[5-(p-pentylphenyl)-2-pyrimidinyl]cyclohexane carbonitrile;
 trans-4-[5-(p-hexylphenyl)-2-pyrimidinyl]cyclohexane carbonitrile;
 trans-4-[5-(p-heptylphenyl)-2-pyrimidinyl]cyclohexane carbonitrile;
 trans-4-[5-(p-octylphenyl)-2-pyrimidinyl]cyclohexane carbonitrile;
 trans-4-[5-(p-nonylphenyl)-2-pyrimidinyl]cyclohexane carbonitrile;
 60 trans-4-[5-(p-decylphenyl)-2-pyrimidinyl]cyclohexane carbonitrile;
 trans-4-[5-(p-methoxyphenyl)-2-pyrimidinyl]cyclohexane carbonitrile;
 trans-4-[5-(p-ethoxyphenyl)-2-pyrimidinyl]cyclohexane carbonitrile;
 trans-4-[5-(p-propyloxyphenyl)-2-pyrimidinyl]cyclohexane carbonitrile;
 trans-4-[5-(p-butyloxyphenyl)-2-pyrimidinyl]cyclohexane carbonitrile;
 65 trans-4-[5-(p-pentyloxyphenyl)-2-pyrimidinyl]cyclohexane carbonitrile;

- trans-4-[5-(p-hexyloxyphenyl)-2-pyrimidinyl]cyclohexane carbonitrile;
 trans-4-[5-(p-heptyloxyphenyl)-2-pyrimidinyl]cyclohexane carbonitrile;
 trans-4-[5-(p-octyloxyphenyl)-2-pyrimidinyl]cyclohexane carbonitrile;
 trans-4-[5-(p-nonyloxyphenyl)-2-pyrimidinyl]cyclohexane carbonitrile;
 5 trans-4-[5-(p-decyloxyphenyl)-2-pyrimidinyl]cyclohexane carbonitrile; 5
 trans-4-[5-(trans-4-methylcyclohexyl)-2-pyrimidinyl]-cyclohexane carbonitrile;
 trans-4-[5-(trans-4-ethylcyclohexyl)-2-pyrimidinyl]-cyclohexane carbonitrile;
 trans-4-[5-(trans-4-propylcyclohexyl)-2-pyrimidinyl]-cyclohexane carbonitrile;
 trans-4-[5-(trans-4-butylcyclohexyl)-2-pyrimidinyl]-cyclohexane carbonitrile;
 10 trans-4-[5-(trans-4-pentylcyclohexyl)-2-pyrimidinyl]-cyclohexane carbonitrile; 10
 trans-4-[5-(trans-4-hexylcyclohexyl)-2-pyrimidinyl]-cyclohexane carbonitrile;
 trans-4-[5-(trans-4-heptylcyclohexyl)-2-pyrimidinyl]-cyclohexane carbonitrile;
 trans-4-[5-(trans-4-octylcyclohexyl)-2-pyrimidinyl]-cyclohexane carbonitrile;
 trans-4-[5-(trans-4-nonylcyclohexyl)-2-pyrimidinyl]-cyclohexane carbonitrile;
 15 trans-4-[5-(trans-4-decylcyclohexyl)-2-pyrimidinyl]-cyclohexane carbonitrile; 15
 trans-4-[5-(trans-4-methoxycyclohexyl)-2-pyrimidinyl]-cyclohexane carbonitrile;
 trans-4-[5-(trans-4-ethoxycyclohexyl)-2-pyrimidinyl]-cyclohexane carbonitrile;
 trans-4-[5-(trans-4-propyloxycyclohexyl)-2-pyrimidinyl]cyclohexane carbonitrile;
 trans-4-[5-(trans-4-butyloxycyclohexyl)-2-pyrimidinyl]cyclohexane carbonitrile;
 20 trans-4-[5-(trans-4-pentyloxycyclohexyl)-2-pyrimidinyl]cyclohexane carbonitrile; 20
 trans-4-[5-(trans-4-hexyloxycyclohexyl)-2-pyrimidinyl]cyclohexane carbonitrile;
 trans-4-[5-(trans-4-heptyloxycyclohexyl)-2-pyrimidinyl]cyclohexane carbonitrile;
 trans-4-[5-(trans-4-octyloxycyclohexyl)-2-pyrimidinyl]cyclohexane carbonitrile;
 trans-4-[5-(trans-4-nonyloxycyclohexyl)-2-pyrimidinyl]cyclohexane carbonitrile;
 25 trans-4-[5-trans-4-decylloxycyclohexyl)-2-pyrimidinyl]cyclohexane carbonitrile; 25
 (+)-trans-p-[5-[4-(2-methylbutyl)cyclohexyl]-2-pyrimidinyl]benzonitrile;
 (+)-trans-p-[5-[4-(3-methylpentyl)cyclohexyl]-2-pyrimidinyl]benzonitrile;
 (+)-trans-p-[5-[4-(4-methylhexyl)cyclohexyl]-2-pyrimidinyl]benzonitrile;
 (+)-trans-4-[5-[p-(methylbutyl)phenyl]-2-pyrimidinyl]cyclohexane carbonitrile;
 30 (+)-trans-4-[5-[p-(3-methylpentyl)phenyl]-2-pyrimidinyl]cyclohexane carbonitrile; 30
 (+)-trans-4-[5-[p-(methylhexyl)phenyl]-2-pyrimidinyl]cyclohexane carbonitrile;
 (+)-trans-4-[5-[trans-4-(2-methylbutyl)cyclohexyl]-2-pyrimidinyl]cyclohexane carbonitrile;
 (+)-trans-4-[5-[trans-4-(3-methylpentyl)cyclohexyl]-2-pyrimidinyl]cyclohexane carbonitrile; and
 (+)-trans-4-[5-trans-4-(4-methylhexyl)cyclohexyl]-2-pyrimidinyl]cyclohexane carbonitrile;
 35 as well as the antipodes of the optically active derivatives. 35
 Especially preferred pyrimidine derivatives of formula I are:
 Trans-p-[5-(4-ethylcyclohexyl)-2-pyrimidinyl]benzonitrile;
 trans-p-[5-(4-pentylcyclohexyl)-2-pyrimidinyl]benzonitrile; and
 trans-p-[5-(4-heptylcyclohexyl)-2-pyrimidinyl]benzonitrile.
 40 According to the process provided by the present invention, the pyrimidine derivatives of formula I 40
 hereinbefore are manufactured by
 a) dehydrating a compound of the general formula



- 50 , wherein A, B, and R have the significance given earlier, 50
 or
 b) for the manufacture of a pyrimidine derivative of formula IA hereinbefore, reacting a compound of the
 general formula



- 60 wherein R and A have the significance given earlier and X represents a fluorine, chlorine or bromine atom, 60
 with copper(II) cyanide, sodium cyanide or potassium cyanide.
 The dehydration of a compound of formula II in accordance with embodiment a) of the foregoing process
 can be carried out using any suitable dehydrating agent such as, for example, phosphorus oxychloride,
 phosphorus pentoxide, thionyl chloride, acetic anhydride or, especially, benzene-sulphonyl chloride and the
 65 like. The dehydration can be carried out in an inert organic solvent such as, for example, a hydrocarbon or 65

halogenated hydrocarbon, if desired, in the presence of a base such as sodium, acetate, pyridine or triethylamine. The dehydration can, however, also be carried out in the absence of an organic solvent. The dehydration is preferably carried out at a temperature between 50°C and the reflux temperature of the mixture. The pressure is not critical; it is, however, advantageous to carry out the dehydration at

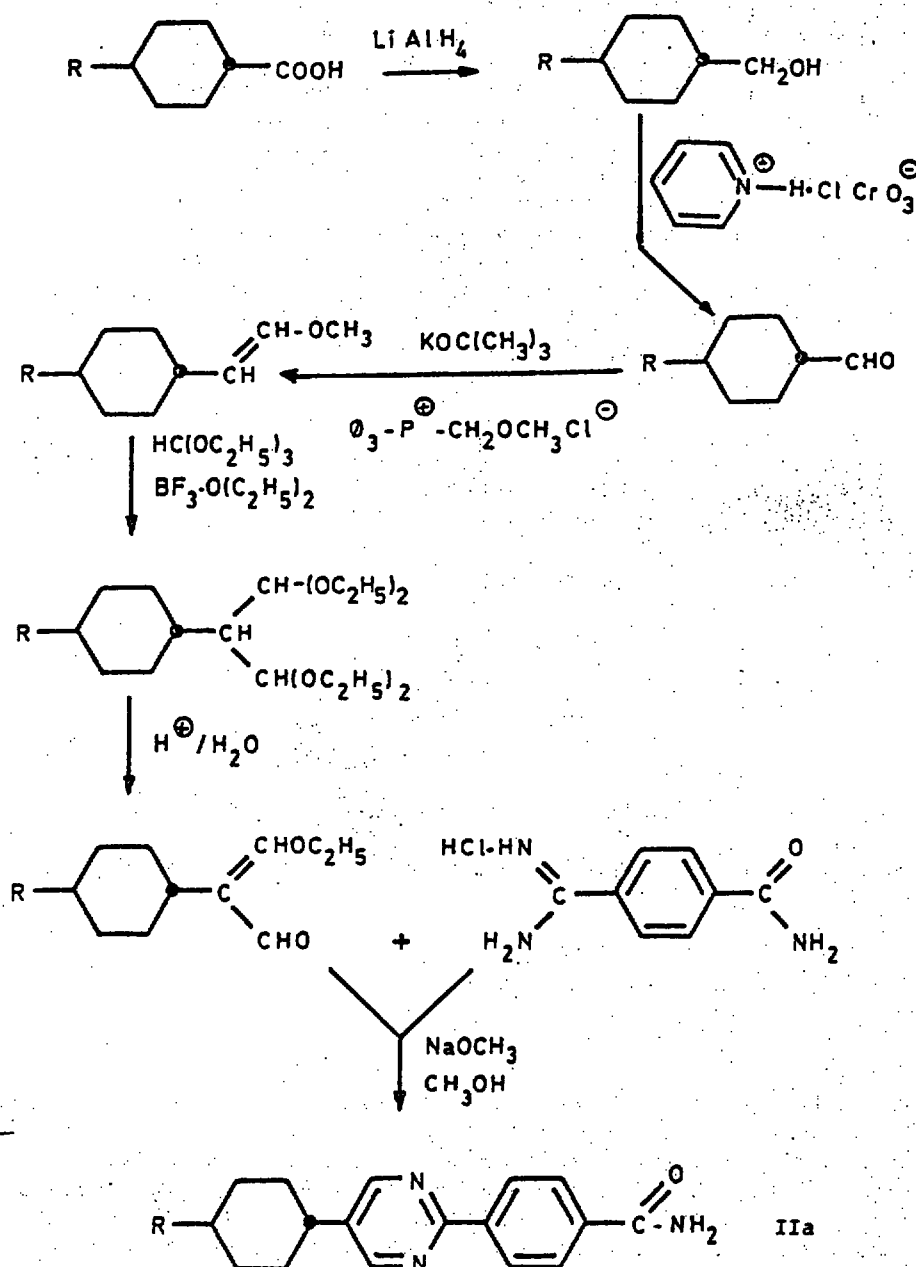
atmospheric pressure.

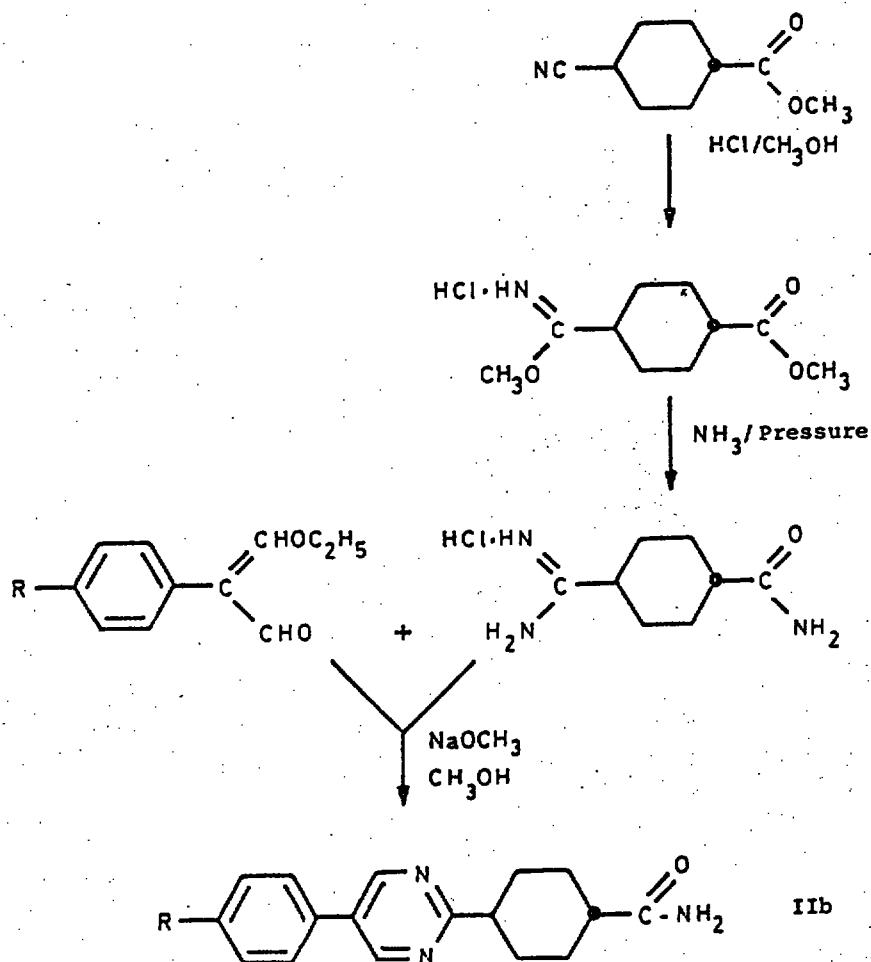
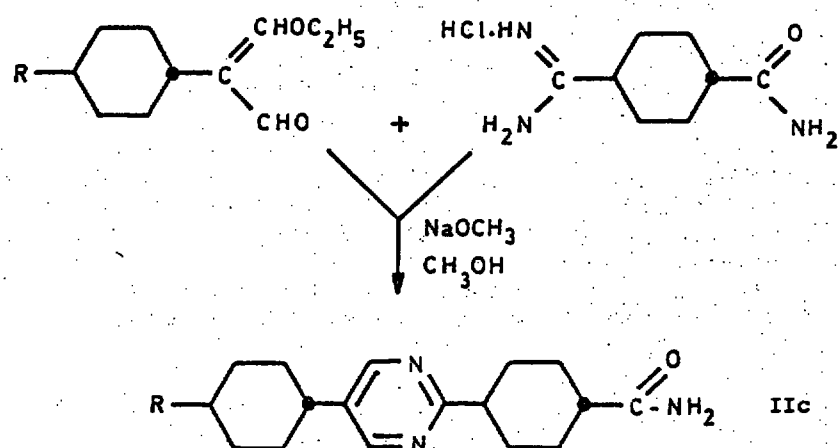
The reaction of a compound of formula III with copper-(I) cyanide, sodium cyanide or potassium cyanide in accordance with embodiment b) of the foregoing process is conveniently carried out in an inert organic solvent such as, for example, ethyleneglycol, tetrahydrofuran, dimethyl-formamide, dimethyl sulphoxide, pyridine or acetonitrile. The temperature and pressure are not critical aspects of this reaction. The reaction is conveniently carried out at atmospheric pressure and at a temperature between room temperature and the boiling point of the reaction mixture. In the compound of formula III X preferably represents a bromine atom.

The preparation of the starting materials of formulae II and III hereinbefore is illustrated in Formula Schemes A to D hereinafter.

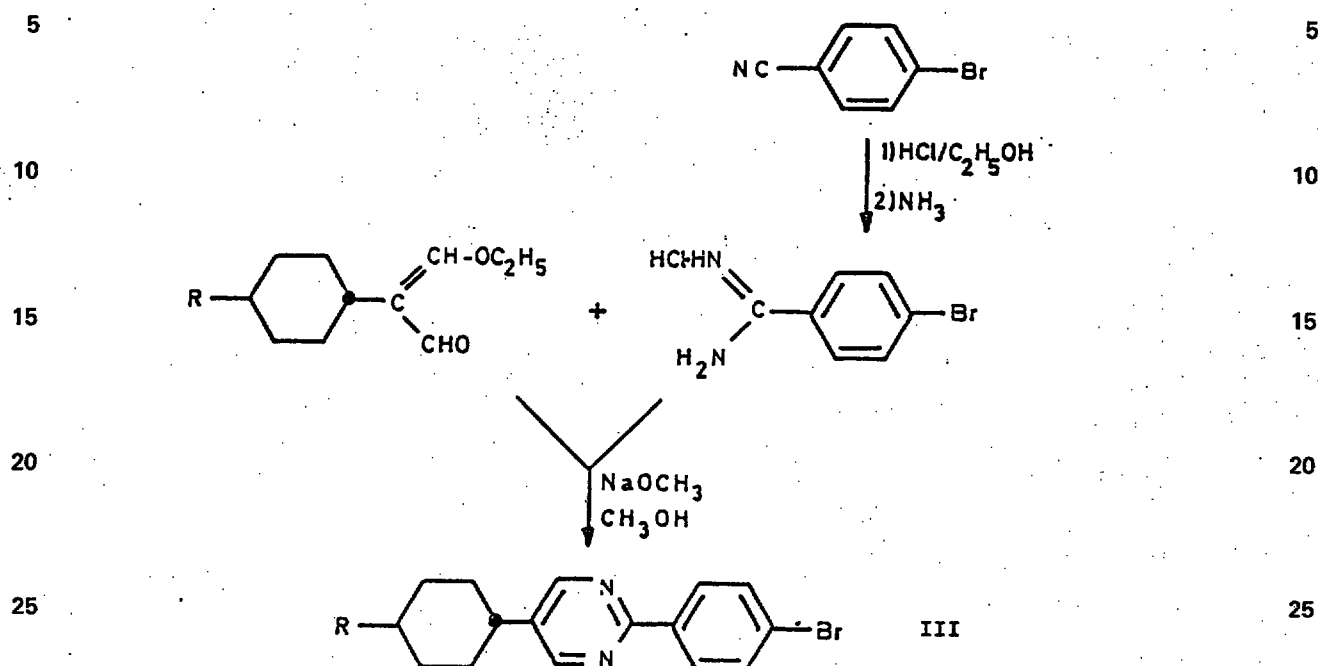
The straight-chain alkyl groups containing 1 to 10 carbon atoms referred to in this specification are, in particular, the methyl, ethyl, propyl, butyl, pentyl, hexyl, heptyl, octyl, nonyl and decyl groups. The straight-chain alkoxy groups containing 1 to 10 carbon atoms are the methoxy, ethoxy, propyloxy, butyloxy, pentyloxy, hexyloxy, heptyloxy, octyloxy, nonyloxy and decyloxy groups. The branched-chain alkyl group of the formula $C_2H_5-CH(CH_3)-(CH_2)_n-$ in which n stands for 1, 2 or 3 is the 2-methylbutyl, 3-methylpentyl or 4-methylhexyl group.

Formula Scheme A



Formula Scheme BFormula Scheme C

Formula Scheme D



30 The acid starting materials in which R represents a branched-chain alkyl group of the aforementioned kind can be prepared according to the processes described by Gray and McDonnell in German Offenlegungsschrift 2 736 772 and in Mol. Cryst. Liq. Cryst. 37 (1976) 189.

The pyrimidine derivatives of formula I can be used in the form of mixtures with other nematic or non-nematic substances such as, for example, with substances from the classes of Schiffs bases, azo- or azoxybenzenes, phenyl benzoates, cyclohexane carboxylic acid phenyl esters, bi- and terphenyls, phenylcyclohexanes, cinnamic acid derivatives, phenyl- and diphenylpyrimidines and the like. Such compounds are known in the art, for example from German Offenlegungsschriften 2 306 738, 2 306 739, 2 429 093, 2 356 085, 2 636 684, 2 459 374, 2 547 737, 2 641 724, 2 708 276, 2 811 001. Many of such nematic or non-nematic substances are, moreover, commercially available.

40 The pyrimidine derivatives of formula I in which R represents a straight-chain alkyl or alkoxy group are present in liquid crystalline mixtures for electro-optical purposes in a weight ratio which preferably corresponds to the eutectic composition. The amount of these pyrimidine derivatives of formula I present in a liquid crystalline mixture is, however, generally between about 1 and about 50 mol percent, preferably between about 5 and about 30 mol percent.

45 The pyrimidine derivatives of formula I in which R represents a branched-chain alkyl group are present in cholesteric mixtures for electro-optical purposes in a weight ratio which is preferably given by the desired pitch of the cholesteric mixture. The amount of these pyrimidine derivatives in a cholesteric mixture containing colouring substances generally lies below about 15 mol percent, preferably below about 5 mol percent. On the other hand, in the case of mixture which do not contain a colouring substance there are often used smaller amounts, preferably less than about 2 mol percent, of these pyrimidine derivatives.

By using pyrimidine derivatives formula I there can be produced mixtures which have considerable advantages over previously known mixtures. Thus, for example, the amount of pyrimidine derivatives of formula I in a mixture can be substantially higher than that of previously known compounds with similar high clearing points. This means, for example, that several pyrimidine derivatives of formula I can be combined in a mixture and this leads to very high clearing points without the mixture thereby having smectic or solid crystalline tendencies. Furthermore, mixtures which contain the pyrimidine derivatives of formula I have a very slight temperature dependence of the threshold potential. This is advantageous, since mixtures with a slight temperature dependence of the electro-optical transmission curves (in rotation cells) are especially well suited for multiplex working.

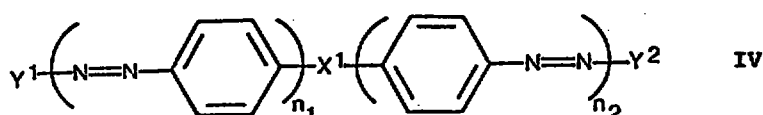
60 A further advantage of the pyrimidine derivatives of formula I is that they enable the production of mixtures having high clearing points and, nevertheless, low viscosities.

The pyrimidine derivatives of formula I can also be used in the form of liquid crystal mixtures which contain colouring substances. In order to achieve high contrasts in liquid crystal displays in which any form of the "guest-host effect" is used, it is important that the dissolved dichroic colouring substances have a high degree of order. This depends not only on the liquid crystal matrix but also on the dichroic colouring

substances which are used. Since the liquid crystal mixtures which contain one or more pyrimidine derivatives of formula I and, if desired, further nematic and/or non-nematic substances have a high degree of order, they are especially suitable as the liquid crystal matrix for mixtures containing colouring substances.

As colouring substances for these mixtures in accordance with the invention there are suitable above all compounds having longish molecules and a relatively rigid molecular part such as, for example, azo or azoxy colouring substances, polyenes and Schiffs bases as well as, surprisingly, anthraquinone derivatives. Preferred colouring substances are compounds of the general formulae:

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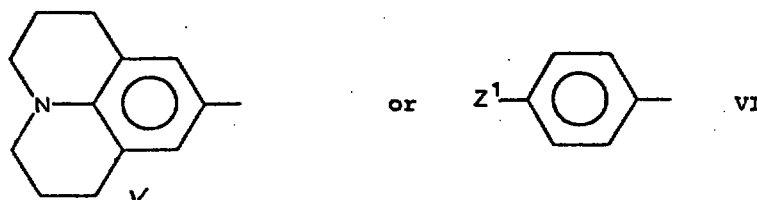


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15 wherein n_1 and n_2 stand for zero, 1 or 2, X^1 represents an azo or azoxy group, Y^1 and Y^2 , which can be the same or different, represent one of the groups

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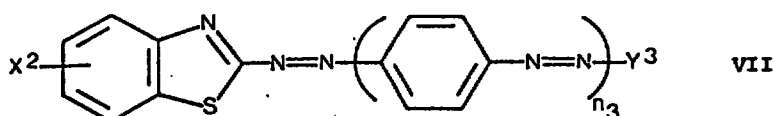
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and Z^1 represents a hydrogen atom, or a cyano, nitro, phenyl, p-substituted phenyl, hydroxy, alkoxy, amino, dialkylamino or pyrrolidyl group; or derivatives of formula IV in which one of the benzene rings additionally carries one or more substituents selected from halogen, methyl, halo-substituted methyl and methoxy;

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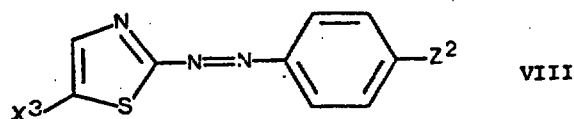
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wherein n_3 stands for zero or 1, Y^3 represents a group of formula V or VI hereinbefore, in which Z^1 represents a dialkylamino or pyrrolidyl group, and X^2 represents a hydrogen or halogen atom or a cyano, nitro, alkyl, alkoxy, optionally substituted phenyl, optionally substituted benzothiazol-2-yl, alkoxy carbonyl or alkylsul-

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40 phenyl group in the 5- or 6-position;

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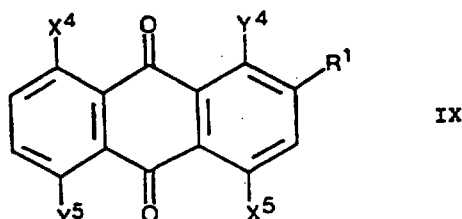


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wherein X^3 represents a cyano, nitro or alkyl group and Z^2 represents a hydroxy, alkoxy or aryl group or an optionally alkyl-substituted or aryl-substituted amino, pyrrolidyl or piperidyl group; or derivatives of formula VIII in which the benzene ring additionally carries one or more substituents selected from halogen, hydroxy, methyl and methoxy;

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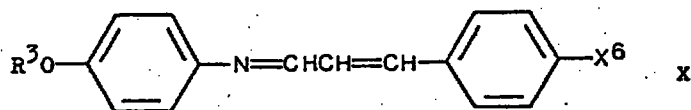
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wherein X^4 and X^5 each represent a hydroxy group, Y^4 and Y^5 each represent an amino group and R^1 represents a group of formula VI hereinbefore or X^4 , Y^5 and R^1 each represent a hydrogen atom, X^5 represents a hydroxy group and Y^4 represents the group $-NHR^2$ or X^4 , X^5 and R^1 each represent a hydrogen

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atom and Y^4 and Y^5 each represent the group $-NHR^2$, R^2 representing a group of formula VI hereinbefore in which Z^1 represents an alkyl, alkoxy or dialkylamino group;

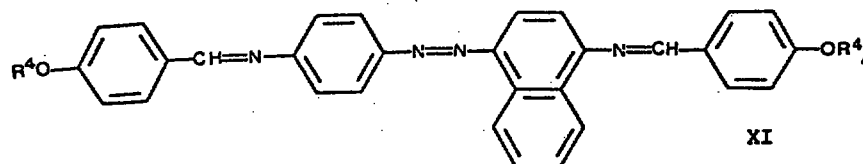
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wherein R^3 represents an alkyl group and X^6 represents a cyano or nitro group;

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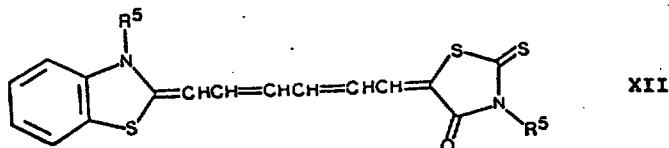
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wherein R^4 represents an alkyl group; and

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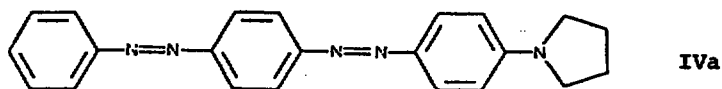
wherein R^5 represents an alkyl group.

30 These compounds are known compounds or analogues of known compounds.

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The following compounds are especially preferred colouring substances:

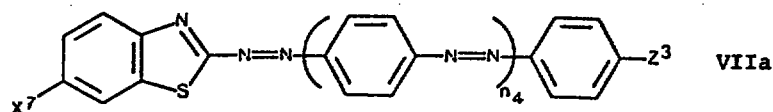
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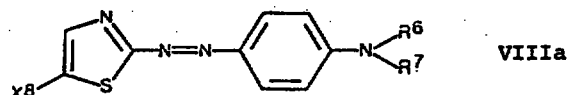
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45 wherein n_4 stands for zero or 1, Z^3 represents a dimethylamino or diethylamino group and X^7 represents a hydrogen atom or a methyl, ethoxy, n-butyloxy, nitro or n-butylsulphonyl group;

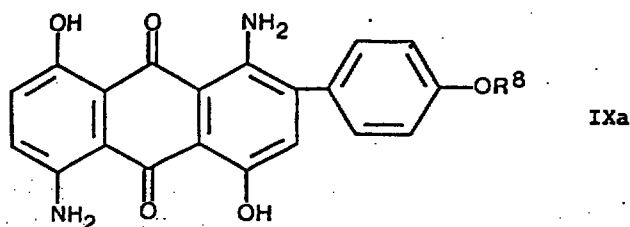
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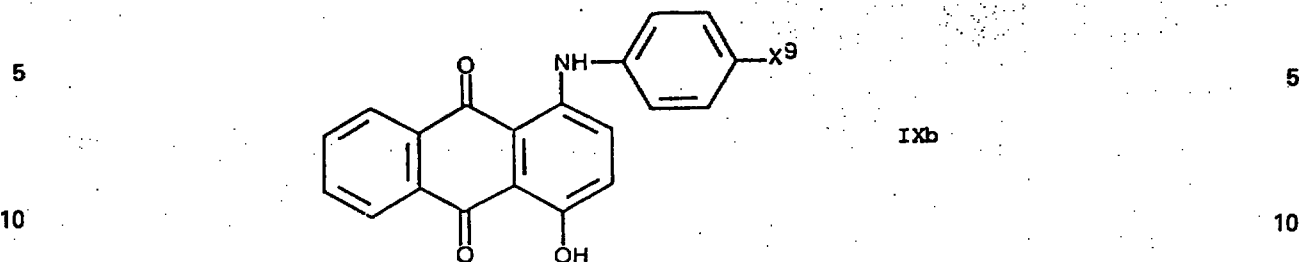


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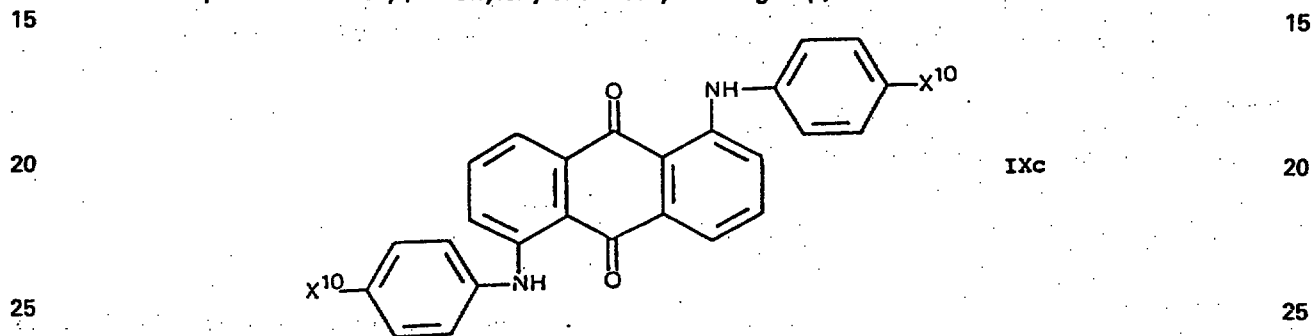
wherein R^6 , R^7 and X^8 each represent a methyl group or R^6 represents a methyl group, X^8 represents a nitro group and R^7 represents a methyl, phenyl or p-n-butyl-phenyl group;



wherein R^8 represents a n-alkyl group containing 1 to 10 carbon atoms;



wherein X^9 represents a n-butyl, n-nonyloxy or dimethylamino group;



wherein X^{10} represents an ethyl, n-butyl, isopropyl, pentyloxy or dimethylamino group;

30 the compound of formula X in which R^3 represents a n-butyl group and X^6 represents a nitro group;

the compound of formula XI in which R^4 represents an ethyl group;

and the compound of formula XII in which R^5 represents an ethyl group.

The mixtures in accordance with the invention which contain colouring substances can contain 1 to about 4 colouring substances. The amount of colouring substance in a liquid crystalline mixture lies, in the case of anthra-quinones, between about 0.2 and about 3 weight percent, preferably between about 1 and about 2 weight percent, and, in the case of the customary colouring substances, between about 0.1 and about 2 weight percent, preferably between about 0.5 and about 1 weight percent.

The production of mixtures which contain, inter alia, pyrimidine derivatives of formula I as well as other nematic and/or non-nematic compounds and/or one or more colouring substances can be carried out in a manner known per se; for example, by heating a mixture of the components to a temperature barely above the clearing point and subsequently cooling the mixture down.

Examples of preferred mixtures are given hereinafter, the percentages being expressed in mol percent unless expressly stated to the contrary and S denotes the degree of order.

45 Mixture 1:

- 19% trans-p-(4-propylcyclohexyl)benzonitrile,
- 34% trans-p-(4-pentylcyclohexyl)benzonitrile,
- 22% trans-p-(4-heptylcyclohexyl)benzonitrile,
- 3% trans-4-[5-(p-butylphenyl)-2-pyrimidinyl]cyclohexane carbonitrile,
- 50 10% trans-4-[5-(p-hexylphenyl)-2-pyrimidinyl]cyclohexane carbonitrile, and
- 12% trans-4-[5-(p-octylphenyl)-2-pyrimidinyl]cyclohexane carbonitrile, melting point $<0^{\circ}\text{C}$; clearing point 77°C .

Mixture 2:

- 55 16% trans-4-propylcyclohexane carboxylic acid p-cyanophenyl ester,
- 9.5% trans-4-butylcyclohexane carboxylic acid p-cyanophenyl ester,
- 14.5% trans-4-pentylcyclohexane carboxylic acid p-cyanophenyl ester,
- 8% p-butylbenzoic acid p'-cyanophenyl ester,
- 8% p-(5-pentyl-2-pyrimidinyl)benzonitrile,
- 60 15% p-(5-heptyl-2-pyrimidinyl)benzonitrile,
- 12% trans-p-[5-(4-ethylcyclohexyl)-2-pyrimidinyl]-benzonitrile, and
- 17% trans-p-[5-(4-heptylcyclohexyl)-2-pyrimidinyl]-benzonitrile, melting point $<0^{\circ}\text{C}$; clearing point 109°C .

Mixture 3:

- 8% p-(5-pentyl-2-pyrimidinyl)benzonitrile,
 14% p-(5-heptyl-2-pyrimidinyl)benzonitrile,
 9% 4'-octyloxy-4-cyanobiphenyl,
 5 40% trans-p-(4-pentylcyclohexyl)benzonitrile, 5
 12% trans-p-[5-(4-ethylcyclohexyl)-2-pyrimidinyl]-benzonitrile, and
 17% trans-p-[5-(4-heptylcyclohexyl)-2-pyrimidinyl]-benzonitrile, melting point <0°C; clearing point 102°C.

Mixture 4:

- 10 8% p-(4-pentyl-2-pyrimidinyl)benzonitrile, 10
 12% p-(5-heptyl-2-pyrimidinyl)benzonitrile,
 46% 4'-pentyl-4-cyanobiphenyl,
 8% 4'-octyloxy-4-cyanobiphenyl,
 11% trans-p-[5-(4-ethylcyclohexyl)-2-pyrimidinyl]-benzonitrile, and
 15 15% trans-p-[5-(4-heptylcyclohexyl)-2-pyrimidinyl]-benzonitrile, melting point <0°C; clearing point 94°C. 15

Mixture 5:

- 5% p-butylbenzoic acid p'-cyanophenyl ester,
 6% p-(5-pentyl-2-pyrimidinyl)benzonitrile,
 20 43% 4'-pentyl-4-cyanobiphenyl, 20
 12% trans-4-propylcyclohexane carboxylic acid p-cyanophenyl ester,
 7% trans-4-butylcyclohexane carboxylic acid p-cyanophenyl ester,
 11% trans-4-pentylcyclohexane carboxylic acid p-cyanophenyl ester,
 11% trans-p-[5-(4-ethylcyclohexyl)-2-pyrimidinyl]-benzonitrile, and
 25 5% trans-p-[5-(4-propylcyclohexyl)-2-pyrimidinyl]-benzonitrile, melting point <0°C; clearing point 75°C. 25

Mixture 6:

- 7% p-(5-pentyl-2-pyrimidinyl)benzonitrile,
 46% 4'-pentyl-4-cyanobiphenyl,
 30 8% trans-4-butylcyclohexane carboxylic acid p-cyanophenyl ester, 30
 12% trans-4-pentylcyclohexane carboxylic acid p-cyanophenyl ester,
 11% trans-p-[5-(4-ethylcyclohexyl)-2-pyrimidinyl]-benzonitrile, and
 16% trans-p-[5-(4-heptylcyclohexyl)-2-pyrimidinyl]-benzonitrile, melting point <0°C; clearing point 97°C.

35 *Mixture 7:* 35

- 8% p-(5-pentyl-2-pyrimidinyl)benzonitrile,
 51% 4'-pentyl-4-cyanobiphenyl,
 9% trans-4-butylcyclohexane carboxylic acid p-cyanophenyl ester,
 14% trans-4-pentylcyclohexane carboxylic acid p-cyanophenyl ester,
 40 12% trans-p-[5-(4-ethylcyclohexyl)-2-pyrimidinyl]-benzonitrile, and 40
 6% trans-p-[5-(4-propylcyclohexyl)-2-pyrimidinyl]-benzonitrile, melting point <0°C; clearing point 78°C.

Mixture 8:

- 9% p-(5-pentyl-2-pyrimidinyl)benzonitrile,
 45 55% 4'-pentyl-4-cyanobiphenyl, 45
 16% trans-5-pentylcyclohexane carboxylic acid p-cyanophenyl ester,
 13% trans-p-[5-(4-ethylcyclohexyl)-2-pyrimidinyl]-benzonitrile, and
 7% trans-p-[5-(4-propylcyclohexyl)-2-pyrimidinyl]-benzonitrile, melting point <0°C; clearing point 80°C.

50 *Mixture 9:* 50

- 8% p-(5-pentyl-2-pyrimidinyl)benzonitrile,
 14% p-(5-heptyl-2-pyrimidinyl)benzonitrile,
 50% 4'-pentyl-4-cyanobiphenyl,
 10% 4'-octyloxy-4-cyanobiphenyl,
 55 12% trans-p-[5-(4-ethylcyclohexyl)-2-pyrimidinyl]-benzonitrile, and 55
 6% trans-p-[5-(4-propylcyclohexyl)-2-pyrimidinyl]-benzonitrile, melting point <0°C; clearing point 77°C.

Mixture 10:

- 7% p-butylbenzoic acid p'-cyanophenyl ester,
 60 7% p-(5-pentyl-2-pyrimidinyl)benzonitrile, 60
 39% trans-p-(4-pentylcyclohexyl)benzonitrile,
 15% trans-4-propylcyclohexane carboxylic acid p-cyanophenyl ester,
 14% trans-4-pentylcyclohexane carboxylic acid p-cyanophenyl ester,
 12% trans-p-[5-(4-ethylcyclohexyl)-2-pyrimidinyl]-benzonitrile, and
 65 6% trans-p-[5-(4-propylcyclohexyl)-2-pyrimidinyl]-benzonitrile, melting point <20°C; clearing point 90°C. 65

Mixture 11:

- 6% p-butylbenzoic acid p'-cyanophenyl ester,
 7% p-(5-pentyl-2-pyrimidinyl)benzonitrile,
 38% trans-p-(4-pentylcyclohexyl)benzonitrile,
 5 14% trans-4-propylcyclohexane carboxylic acid p-cyanophenyl ester, 5
 12% trans-4-pentylcyclohexane carboxylic acid p-cyanophenyl ester,
 11.5% p-[5-(4-butylphenyl)-2-pyrimidinyl]benzonitrile, and
 11.5% trans-p-[5-(4-ethylcyclohexyl)-2-pyrimidinyl]-benzonitrile, melting point <20°C; clearing point 94°C.

Mixture 12:

- 4% p-butylbenzoic acid p'-cyanophenyl ester,
 4% p-(5-pentyl-2-pyrimidinyl)benzonitrile,
 8% p-(5-heptyl-2-pyrimidinyl)benzonitrile,
 35% 4'-pentyl-4-cyanobiphenyl,
 15 27% trans-p-(4-pentylcyclohexyl)benzonitrile, 15
 5% trans-4-butylcyclohexane carboxylic acid p-cyanophenyl ester,
 8% p-[5-(4-butylphenyl)-2-pyrimidinyl]benzonitrile, and
 9% trans-p-[5-(4-ethylcyclohexyl)-2-pyrimidinyl]-benzonitrile, melting point <-10°C; clearing point 72°C.

Mixture 13:

- 5% p-(5-pentyl-2-pyrimidinyl)benzonitrile,
 9% p-(5-heptyl-2-pyrimidinyl)benzonitrile,
 38% 4'-pentyl-4-cyanobiphenyl,
 30% trans-p-(4-pentylcyclohexyl)benzonitrile,
 25 9% p-[5-(4-butylphenyl)-2-pyrimidinyl]benzonitrile, and 25
 9% trans-p-[5-(4-ethylcyclohexyl)-2-pyrimidinyl]-benzonitrile, melting point <-10°C; clearing point 75°C.

Mixture 14:

- 5% p-(5-pentyl-2-pyrimidinyl)benzonitrile,
 30 9% p-(5-heptyl-2-pyrimidinyl)benzonitrile, 30
 38% 4'-pentyl-4-cyanobiphenyl,
 10.4% trans-4-propylcyclohexane carboxylic acid p-cyanophenyl ester,
 5.6% trans-4-butylcyclohexane carboxylic acid p-cyanophenyl ester,
 9% trans-4-pentylcyclohexane carboxylic acid p-cyanophenyl ester,
 35 10% trans-p-[5-(4-ethylcyclohexyl)-2-pyrimidinyl]-benzonitrile, and 35
 13% trans-p-[5-(4-heptylcyclohexyl)-2-pyrimidinyl]-benzonitrile, melting point <-10°C; clearing point 91°C.

Mixture 15:

- 5.5% p-(5-pentyl-2-pyrimidinyl)benzonitrile,
 40 10% p-(5-heptyl-2-pyrimidinyl)benzonitrile, 40
 33% trans-p-(4-pentylcyclohexyl)benzonitrile,
 11.5% trans-4-propylcyclohexane carboxylic acid p-cyanophenyl ester,
 6% trans-4-butylcyclohexane carboxylic acid p-cyanophenyl ester,
 10% trans-4-pentylcyclohexane carboxylic acid p-cyanophenyl ester,
 45 10% trans-p-[5-(4-ethylcyclohexyl)-2-pyrimidinyl]-benzonitrile, and 45
 14% trans-p-[5-(4-heptylcyclohexyl)-2-pyrimidinyl]-benzonitrile, melting point <-10°C; clearing point 98°C.

Mixture 16:

- 7% p-(5-pentyl-2-pyrimidinyl)benzonitrile,
 50 13% p-(5-heptyl-2-pyrimidinyl)benzonitrile, 50
 47% 4'-pentyl-4-cyanobiphenyl,
 9% 4'-octyloxy-4-cyanobiphenyl,
 8% 4''-pentyl-4-cyanop-terphenyl, and
 16% trans-p-[5-(4-heptylcyclohexyl)-2-pyrimidinyl]-benzonitrile, melting point <0°C; clearing point 95°C.
 55 55

Mixture 17:

- 5% p-butylbenzoic acid p'-cyanophenyl ester,
 5% p-(5-pentyl-2-pyrimidinyl)benzonitrile,
 40% 4'-pentyl-4-cyanobiphenyl,
 60 11% trans-4-propylcyclohexane carboxylic acid p-cyanophenyl ester, 60
 6% trans-4-butylcyclohexane carboxylic acid p-cyanophenyl ester,
 9% trans-4-pentylcyclohexane carboxylic acid p-cyanophenyl ester,
 10% trans-p-[5-(4-ethylcyclohexyl)-2-pyrimidinyl]-benzonitrile, and
 14% trans-p-[5-(4-heptylcyclohexyl)-2-pyrimidinyl]-benzonitrile, melting point <-10°C; clearing point 93°C.

23

Mixture 18:

- 6.5% p-(5-pentyl-2-pyrimidinyl)benzonitrile,
12% p-(5-heptyl-2-pyrimidinyl)benzonitrile,
47% 4'-pentyl-4-cyanobiphenyl,
5 8% 4'-octyloxy-4-cyanobiphenyl, 5
11% p-[5-(4-butylphenyl)-2-pyrimidinyl]benzonitrile, and
15.5% trans-p-[5-(4-heptylcyclohexyl)-2-pyrimidinyl]-benzonitrile, melting point <0°C; clearing point 98°C.

Mixture 19:

- 6% p-(5-pentyl-2-pyrimidinyl)benzonitrile, 10
42% 4'-pentyl-4-cyanobiphenyl,
7% trans-4-butylcyclohexane carboxylic acid p-cyanophenyl ester,
10% trans-4-pentylcyclohexane carboxylic acid p-cyanophenyl ester,
10% p-[5-(4-butylphenyl)-2-pyrimidinyl]benzonitrile,
15 10.5% trans-p-[5-(4-ethylcyclohexyl)-2-pyrimidinyl]-benzonitrile, and 15
14.5% trans-p-[5-(4-heptylcyclohexyl)-2-pyrimidinyl]-benzonitrile, melting point <0°C; clearing point 112°C.

Mixture 20:

- 8.1% p-(5-pentyl-2-pyrimidinyl)benzonitrile, 20
15.1% p-(5-heptyl-2-pyrimidinyl)benzonitrile,
16.2% trans-4-propylcyclohexane carboxylic acid p-cyanophenyl ester,
9.7% trans-4-butylcyclohexane carboxylic acid p-cyanophenyl ester,
14.8% trans-4-pentylcyclohexane carboxylic acid p-cyanophenyl ester,
25 23.6% trans-4-pentylcyclohexane carboxylic acid p-methoxyphenyl ester, and 25
12.5% trans-p-[5-(4-ethylcyclohexyl)-2-pyrimidinyl]-benzonitrile, melting point <0°C; clearing point 76°C.

Mixture 21:

- 7% p-butylbenzoic acid p'-cyanophenyl ester,
30 8% p-(5-pentyl-2-pyrimidinyl)benzonitrile, 30
53% 4'-pentyl-4-cyanobiphenyl,
14% trans-4-pentylcyclohexane carboxylic acid p-cyanophenyl ester,
12% trans-p-[5-(4-ethylcyclohexyl)-2-pyrimidinyl]-benzonitrile, and
6% trans-p-[5-(4-propylcyclohexyl)-2-pyrimidinyl]-benzonitrile, melting point <0°C; clearing point 77°C.
35 35

Mixture 22:

- 5% p-(5-pentyl-2-pyrimidinyl)benzonitrile,
10% p-(5-heptyl-2-pyrimidinyl)benzonitrile,
40% 4'-pentyl-4-cyanobiphenyl,
40 30% trans-p-(4-pentylcyclohexyl)benzonitrile, 40
10% trans-p-[5-(4-ethylcyclohexyl)-2-pyrimidinyl]-benzonitrile, and
5% trans-p-[5-(4-propylcyclohexyl)-2-pyrimidinyl]-benzonitrile, melting point <-10°C; clearing point 70°C.

Mixture 23:

- 42% 4'-pentyl-4-cyanobiphenyl, 45
33% trans-p-(4-pentylcyclohexyl)benzonitrile,
10.5% p-[5-(4-butylphenyl)-2-pyrimidinyl]benzonitrile,
10% trans-p-[5-(4-ethylcyclohexyl)-2-pyrimidinyl]-benzonitrile, and
4.5% trans-p-[5-(4-propylcyclohexyl)-2-pyrimidinyl]-benzonitrile, melting point <-10°C; clearing point 87°C.
50 50

Mixture 24:

- 5% p-butylbenzoic acid p'-cyanophenyl ester,
6% p-(5-pentyl-2-pyrimidinyl)benzonitrile,
55 11% p-(5-heptyl-2-pyrimidinyl)benzonitrile, 55
12% trans-4-propylcyclohexane carboxylic acid p-cyanophenyl ester,
7% trans-4-butylcyclohexane carboxylic acid p-cyanophenyl ester,
10% trans-4-pentylcyclohexane carboxylic acid p-cyanophenyl ester,
24% trans-4-pentylcyclohexane carboxylic acid p-(propyloxy)phenyl ester,
60 10.5% trans-p-[5-(4-ethylcyclohexyl)-2-pyrimidinyl]-benzonitrile, and 60
14.5% trans-p-[5-(4-heptylcyclohexyl)-2-pyrimidinyl]-benzonitrile, melting point <5°C; clearing point 99°C.

Mixture 25:

- 5% p-butylbenzoic acid p'-cyanophenyl ester,
65 6% p-[5-pentyl-2-pyrimidinyl]benzonitrile, 65

- 11% p-[5-heptyl-2-pyrimidinyl]benzonitrile,
 12% trans-4-propylcyclohexane carboxylic acid p-cyanophenyl ester,
 7% trans-4-butylcyclohexane carboxylic acid p-cyanophenyl ester,
 10% trans-4-pentylcyclohexane carboxylic acid p-cyanophenyl ester,
 5 24% trans-4-pentylcyclohexane carboxylic acid p-(propyloxy)phenyl ester,
 10.5% p-[5-(4-butylphenyl)-2-pyrimidinyl]benzonitrile, and
 14.5% trans-p-[5-(4-heptylcyclohexyl)-2-pyrimidinyl]-benzonitrile, melting point <20°C; clearing point 102°C. 5
- 10 **Mixture 26:** 10
 4.4% p-(5-Pentyl-2-pyrimidinyl)benzonitrile,
 7.8% p-(5-heptyl-2-pyrimidinyl)benzonitrile,
 35.6% 4'-pentyl-4-cyanobiphenyl,
 9.3% trans-4-propylcyclohexane carboxylic acid p-cyanophenyl ester,
 15 7.7% trans-4-pentylcyclohexane carboxylic acid p-cyanophenyl ester, 15
 21.0% trans-4-butylcyclohexane carboxylic acid p-(hexyloxy)phenyl ester,
 8.8% trans-p-[5-(4-ethylcyclohexyl)-2-pyrimidinyl]-benzonitrile, and
 5.4% trans-p-[5-(4-heptylcyclohexyl)-2-pyrimidinyl]-benzonitrile, melting point <-10°C; clearing point 72°C.
- 20 **Mixture 27:** 20
 4.4% p-(5-Pentyl-2-pyrimidinyl)benzonitrile,
 35.3% 4'-pentyl-4-cyanobiphenyl,
 9.7% trans-4-propylcyclohexane carboxylic acid p-cyanophenyl ester,
 25 7.7% trans-4-pentylcyclohexane carboxylic acid p-cyanophenyl ester, 25
 13.6% trans-4-pentylcyclohexane carboxylic acid p-(methoxy)phenyl ester,
 8.5% 2-(4-cyanophenyl)-5-(4-butylphenyl)pyrimidine,
 8.8% trans-p-[5-(4-ethylcyclohexyl)-2-pyrimidinyl]-benzonitrile, and
 12.0% trans-p-[5-(4-heptylcyclohexyl)-2-pyrimidinyl]-benzonitrile, melting point <-10°C; clearing point 104°C. 30
- Mixture 28:**
 38.2% 4'-Pentyl-4-cyanobiphenyl,
 4.9% p-(5-pentyl-2-pyrimidinyl)benzonitrile,
 35 8.8% p-(5-heptyl-2-pyrimidinyl)benzonitrile, 35
 10.3% trans-4-propylcyclohexane carboxylic acid p-cyanophenyl ester,
 8.7% trans-4-pentylcyclohexane carboxylic acid p-cyanophenyl ester,
 23.2% trans-4-butylcyclohexane carboxylic acid p-(hexyloxy)phenyl ester,
 2.9% trans-4-[5-(4-propylphenyl)-2-pyrimidinyl]-cyclohexane carbonitrile, and
 40 3.1% trans-4-[5-(4-pentylphenyl)-2-pyrimidinyl]-cyclohexane carbonitrile, melting point <-10°C; clearing point 57°C. 40
- Mixture 29:**
 35.5% 4'-Pentyl-4-cyanobiphenyl,
 45 4.4% p-(5-pentyl-2-pyrimidinyl)benzonitrile, 45
 7.8% p-(5-heptyl-2-pyrimidinyl)benzonitrile,
 9.3% trans-4-propylcyclohexane carboxylic acid p-cyanophenyl ester,
 7.7% trans-4-pentylcyclohexane carboxylic acid p-cyanophenyl ester,
 20.8% trans-4-butylcyclohexane carboxylic acid p-(hexyloxy)phenyl ester,
 50 4.0% trans-p-[5-(4-propylcyclohexyl)-2-pyrimidinyl]-benzonitrile, and 50
 10.5% trans-4-[5-(4-heptylphenyl)-2-pyrimidinyl]-cyclohexane carbonitrile, melting point <-10°C; clearing point 68°C.
- Mixture 30:**
 37.0% 4'-Pentyl-4-cyanobiphenyl, 55
 10.0% trans-4-propylcyclohexane carboxylic acid p-cyanophenyl ester,
 8.0% trans-4-pentylcyclohexane carboxylic acid p-cyanophenyl ester,
 14.0% trans-4-pentylcyclohexane carboxylic acid p-(methoxy)phenyl ester,
 9.0% 2-(4-cyanophenyl)-5-(4-butylphenyl)pyrimidine,
 60 9.0% trans-p-[5-(4-ethylcyclohexyl)-2-pyrimidinyl]-benzonitrile, 60
 13.0% trans-p-[5-(4-heptylcyclohexyl)-2-pyrimidinyl]-benzonitrile, melting point <-10°C; clearing point 106°C.

**Mixture 31:**

38.0% 4'-Pentyl-4-cyanobiphenyl,
10.0% trans-4-propylcyclohexane carboxylic acid p-cyanophenyl ester,
9.0% trans-4-pentylcyclohexane carboxylic acid p-cyanophenyl ester,
5 15.0% trans-4-pentylcyclohexane carboxylic acid p-(methoxy)phenyl ester,
9.0% trans-p-[5-(4-ethylcyclohexyl)-2-pyrimidinyl]-benzonitrile,
6.0% trans-p-[5-(4-pentylcyclohexyl)-2-pyrimidinyl]-benzonitrile, and
13.0% trans-p-[5-(4-heptylcyclohexyl)-2-pyrimidinyl]-benzonitrile, melting point <-10°C; clearing point
102°C.

Mixture 32:

6.4% p-(5-Pentyl-2-pyrimidinyl)benzonitrile,
11.9% p-(5-heptyl-2-pyrimidinyl)benzonitrile,
7.5% trans-4-butylcyclohexane carboxylic acid p-cyanophenyl ester,
15 11.6% trans-4-pentylcyclohexane carboxylic acid p-cyanophenyl ester,
19.3% trans-4-pentylcyclohexane carboxylic acid p-(methoxy)phenyl ester,
26.2% trans-4-pentylcyclohexane carboxylic acid p-(propyloxy)phenyl ester,
11.1% trans-p-[5-(4-ethylcyclohexyl)-2-pyrimidinyl]-benzonitrile, and
6.0% trans-p-[5-(4-butylcyclohexyl)-2-pyrimidinyl]-benzonitrile, melting point <10°C; clearing point 83°C.

Mixture 33:

5.0% p-(5-Pentyl-2-pyrimidinyl)benzonitrile,
9.2% p-(5-heptyl-2-pyrimidinyl)benzonitrile,
39.1% 4'-pentyl-4-cyanobiphenyl,
25 5.7% trans-4-butylcyclohexane carboxylic acid p-cyanophenyl ester,
9.1% trans-4-pentylcyclohexane carboxylic acid p-cyanophenyl ester,
22.2% trans-4-pentylcyclohexane carboxylic acid p-(propyloxy)phenyl ester, and
9.7% trans-p-[5-(4-ethylcyclohexyl)-2-pyrimidinyl]-benzonitrile, melting point <0°C; clearing point 64°C.

Mixture 34:

4.7% p-(5-Pentyl-2-pyrimidinyl)benzonitrile,
8.5% p-(5-heptyl-2-pyrimidinyl)benzonitrile,
37.7% 4'-pentyl-4-cyanobiphenyl,
5.3% trans-4-butylcyclohexane carboxylic acid p-cyanophenyl ester,
35 8.4% trans-4-pentylcyclohexane carboxylic acid p-cyanophenyl ester,
21.3% trans-4-pentylcyclohexane carboxylic acid p-(propyloxy)phenyl ester,
9.3% trans-p-[5-(4-ethylcyclohexyl)-2-pyrimidinyl]-benzonitrile, and
4.8% trans-p-[5-(4-butylcyclohexyl)-2-pyrimidinyl]-benzonitrile, melting point <0°C; clearing point 71°C.

Mixture 35:

34.0% 4'-Pentyl-4-cyanobiphenyl,
5.0% trans-4-butylcyclohexane carboxylic acid p-cyanophenyl ester,
8.0% trans-4-pentylcyclohexane carboxylic acid p-cyanophenyl ester,
13.0% trans-4-pentylcyclohexane carboxylic acid p-(methoxy)phenyl ester,
45 19.0% trans-4-pentylcyclohexane carboxylic acid p-(propyloxy)phenyl ester,
9.0% trans-p-[5-(4-ethylcyclohexyl)-2-pyrimidinyl]-benzonitrile,
4.0% trans-p-[5-(4-butylcyclohexyl)-2-pyrimidinyl]-benzonitrile, and
8.0% trans-p-[5-(4-pentylcyclohexyl)-2-pyrimidinyl]-benzonitrile, melting point <-10°C; clearing point
87°C.

Mixture 36:

40.0% 4'-Pentyl-4-cyanobiphenyl,
7.0% 4'-octyloxy-4-cyanobiphenyl,
5.0% p-(5-pentyl-2-pyrimidinyl)benzonitrile,
55 10.0% p-(5-heptyl-2-pyrimidinyl)benzonitrile,
23.0% trans-4-pentylcyclohexane carboxylic acid p-(propyloxy)phenyl ester,
10.0% trans-p-[5-(4-ethylcyclohexyl)-2-pyrimidinyl]-benzonitrile,
5.0% trans-p-[5-(4-butylcyclohexyl)-2-pyrimidinyl]-benzonitrile, melting point <0°C; clearing point 72°C.

Mixture 37:

35.0% 4'-Pentyl-4-cyanobiphenyl,
19.0% 4'-pentyloxy-4-cyanobiphenyl,
4.0% p-(5-pentyl-2-pyrimidinyl)benzonitrile,
8.0% p-(5-heptyl-2-pyrimidinyl)benzonitrile,
65 20.0% trans-4-pentylcyclohexane carboxylic acid p-(propyloxy)phenyl ester,

9.0% trans-p-[5-(4-ethylcyclohexyl)-2-pyrimidinyl]-benzonitrile, and
5.0% trans-p-[5-(4-butylcyclohexyl)-2-pyrimidinyl]-benzonitrile, melting point <10°C; clearing point 73°C.

Mixture 38:

- | | | |
|----|--|----|
| 5 | 7.0% p-Butylbenzoic acid p'-cyanophenyl ester,
8.0% p-(5-pentyl-2-pyrimidinyl)benzonitrile,
15.0% p-(5-heptyl-2-pyrimidinyl)benzonitrile,
10.0% trans-4-butylcyclohexane carboxylic acid p-cyanophenyl ester,
14.0% trans-4-pentylcyclohexane carboxylic acid p-cyanophenyl ester, | 5 |
| 10 | 25.0% trans-4-butylcyclohexane carboxylic acid p-(ethoxy)phenyl ester,
13.0% trans-p-[5-(4-ethylcyclohexyl)-2-pyrimidinyl]-benzonitrile, and
8.0% trans-p-[5-(4-pentylcyclohexyl)-2-pyrimidinyl]-benzonitrile, melting point <10°C; clearing point 88°C. | 10 |

Mixture 39:

- | | | |
|----|---|----|
| 15 | 5.0% p-Butylbenzoic acid p'-cyanophenyl ester,
6.0% p-(5-pentyl-2-pyrimidinyl)benzonitrile,
10.0% p-(5-heptyl-2-pyrimidinyl)benzonitrile,
7.0% trans-4-butylcyclohexane carboxylic acid p-cyanophenyl ester, | 15 |
| 20 | 11.0% trans-4-pentylcyclohexane carboxylic acid p-cyanophenyl ester,
19.0% trans-4-butylcyclohexane carboxylic acid p-(ethoxy)phenyl ester,
20.0% 4'-heptyl-4-cyanobiphenyl,
10.0% trans-p-[5-(4-ethylcyclohexyl)-2-pyrimidinyl]-benzonitrile,
5.0% trans-p-[5-(4-butylcyclohexyl)-2-pyrimidinyl]-benzonitrile, and | 20 |
| 25 | 7.0% trans-p-[5-(4-pentylcyclohexyl)-2-pyrimidinyl]-benzonitrile, melting point <0°C; clearing point 89°C. | 25 |

Mixture 40:

- | | | |
|----|---|----|
| 30 | 19.0% 4'-Heptyl-4-cyanobiphenyl,
5.0% p-butylbenzoic acid p'-cyanophenyl ester,
6.0% p-(5-pentyl-2-pyrimidinyl)benzonitrile,
10.0% p-(5-heptyl-2-pyrimidinyl)benzonitrile,
7.0% trans-4-butylcyclohexane carboxylic acid p-cyanophenyl ester,
10.0% trans-4-pentylcyclohexane carboxylic acid p-cyanophenyl ester,
19.0% trans-4-butylcyclohexane carboxylic acid p-(ethoxy)phenyl ester, | 30 |
| 35 | 10.0% trans-p-[5-(4-ethylcyclohexyl)-2-pyrimidinyl]-benzonitrile, and
14.0% trans-p-[5-(4-heptylcyclohexyl)-2-pyrimidinyl]-benzonitrile, melting point <0°C; clearing point 93°C. | 35 |

Mixture 41:

- | | | |
|----|--|----|
| 40 | 4.0% p-Butylbenzoic acid p'-cyanophenyl ester,
5.0% p-(5-pentyl-2-pyrimidinyl)benzonitrile,
9.0% p-(5-heptyl-2-pyrimidinyl)benzonitrile,
29.0% trans-p-(4-pentylcyclohexyl)benzonitrile,
6.0% trans-4-butylcyclohexane carboxylic acid p-cyanophenyl ester,
9.0% trans-4-pentylcyclohexane carboxylic acid p-cyanophenyl ester, | 40 |
| 45 | 16.0% trans-4-butylcyclohexane carboxylic acid p-(ethoxy)phenyl ester,
9.0% trans-p-[5-(4-ethylcyclohexyl)-2-pyrimidinyl]-benzonitrile, and
13.0% trans-p-[5-(4-heptylcyclohexyl)-2-pyrimidinyl]-benzonitrile, melting point <-10°C; clearing point 93°C. | 45 |

Mixture 42:

- | | | |
|----|---|----|
| 50 | 16.0% 4'-Heptyl-4-cyanobiphenyl,
4.0% p-butylbenzoic acid p'-cyanophenyl ester,
5.0% p-(5-pentyl-2-pyrimidinyl)benzonitrile,
9.0% p-(5-heptyl-2-pyrimidinyl)benzonitrile, | 50 |
| 55 | 5.0% trans-4-butylcyclohexane carboxylic acid p-cyanophenyl ester,
9.0% trans-4-pentylcyclohexane carboxylic acid p-cyanophenyl ester,
16.0% trans-4-butylcyclohexane carboxylic acid p-(ethoxy)phenyl ester,
15.0% trans-4-pentylcyclohexane carboxylic acid p-(methoxy)phenyl ester,
9.0% trans-p-[5-(4-ethylcyclohexyl)-2-pyrimidinyl]-benzonitrile, and | 55 |
| 60 | 12.0% trans-p-[5-(4-heptylcyclohexyl)-2-pyrimidinyl]-benzonitrile, melting point <-10°C; clearing point 89°C. | 60 |

Mixture 43:

- | | | |
|----|--|----|
| 65 | 8.0% p-Butylbenzoic acid p'-cyanophenyl ester,
9.0% p-(5-pentyl-2-pyrimidinyl)benzonitrile, | 65 |
|----|--|----|

- 16.0% p-(5-heptyl-2-pyrimidinyl)benzonitrile,
 10.0% trans-4-butylcyclohexane carboxylic acid p-cyanophenyl ester,
 16.0% trans-4-pentylcyclohexane carboxylic acid p-cyanophenyl ester,
 27.0% trans-4-butylcyclohexane carboxylic acid p-(ethoxy)phenyl ester, and
 5 14.0% trans-p-[5-(4-ethylcyclohexyl)-2-pyrimidinyl]-benzonitrile, melting point <10°C; clearing point 77°C. 5

Mixture 44:

- 7.0% p-Butylbenzoic acid p'-cyanophenyl ester,
 8.0% p-(5-pentyl-2-pyrimidinyl)benzonitrile,
 10 15.0% p-(5-heptyl-2-pyrimidinyl)benzonitrile, 10
 10.0% trans-4-butylcyclohexane carboxylic acid p-cyanophenyl ester,
 14.0% trans-4-pentylcyclohexane carboxylic acid p-cyanophenyl ester,
 26.0% trans-4-butylcyclohexane carboxylic acid p-(ethoxy)phenyl ester,
 8.0% trans-p-[5-(4-ethylcyclohexyl)-2-pyrimidinyl]-benzonitrile, and
 15 12.0% trans-p-[5-(4-pentylcyclohexyl)-2-pyrimidinyl]-benzonitrile, melting point <0°C; clearing point 91°C. 15

Mixture 45:

- 6.0% p-Butylbenzoic acid p'-cyanophenyl ester,
 7.0% p-(5-pentyl-2-pyrimidinyl)benzonitrile,
 20 13.0% p-(5-heptyl-2-pyrimidinyl)benzonitrile, 20
 8.0% trans-4-butylcyclohexane carboxylic acid p-cyanophenyl ester,
 12.0% trans-4-pentylcyclohexane carboxylic acid p-cyanophenyl ester,
 22.0% trans-4-butylcyclohexane carboxylic acid p-(ethoxy)phenyl ester,
 20.0% trans-4-pentylcyclohexane carboxylic acid p-(methoxy)phenyl ester, and
 25 12.0% trans-p-[5-(4-ethylcyclohexyl)-2-pyrimidinyl]-benzonitrile, melting point <10°C; clearing point 74°C. 25

Mixture 46:

- 5.0 o/o p-Butylbenzoic acid p'-cyanophenyl ester,
 6.0 o/o p-(5-pentyl-2-pyrimidinyl)benzonitrile,
 30 10.0 o/o p-(5-heptyl-2-pyrimidinyl)benzonitrile, 30
 12.0 o/o trans-4-propylcyclohexane carboxylic acid p-cyanophenyl ester,
 10.0 o/o trans-pentylcyclohexane carboxylic acid p-cyanophenyl ester,
 19.0 o/o trans-4-butylcyclohexane carboxylic acid p-(ethoxy)phenyl ester,
 17.0 o/o trans-4-pentylcyclohexane carboxylic acid p-(methoxy)phenyl ester,
 35 7.0 o/o trans-p-[5-(4-pentylcyclohexyl)-2-pyrimidinyl]-benzonitrile, and 35
 14.0 o/o trans-p-[5-(4-heptylcyclohexyl)-2-pyrimidinyl]benzonitrile, melting point <0°C; clearing point 97°C.

Mixture 47:

- 40 6.0 o/o p-butylbenzoic acid p'-cyanophenyl ester, 40
 6.0 o/o p-(5-pentyl-2-pyrimidinyl)benzonitrile,
 12.0 o/o p-(5-heptyl-2-pyrimidinyl)benzonitrile,
 13.0 o/o trans-4-propylcyclohexane carboxylic acid p-cyanophenyl ester,
 12.0 o/o trans-4-pentylcyclohexane carboxylic acid p-cyanophenyl ester,
 45 21.0 o/o trans-4-butylcyclohexane carboxylic acid p-(ethoxy)phenyl ester, 45
 19.0 o/o trans-4-pentylcyclohexane carboxylic acid p-(methoxy)phenyl ester, and
 11.0 o/o trans-p-[5-(4-ethylcyclohexyl)-2-pyrimidinyl]-benzonitrile, melting point <0°C; clearing point 74°C.

Mixture 48:

- 50 6.0 o/o p-Butylbenzoic acid p'-cyanophenyl ester, 50
 6.0 o/o p-(5-pentyl-2-pyrimidinyl)benzonitrile,
 11.0 o/o p-(5-heptyl-2-pyrimidinyl)benzonitrile,
 13.0 o/o trans-4-propylcyclohexane carboxylic acid p-cyanophenyl ester,
 11.0 o/o trans-4-pentylcyclohexane carboxylic acid p-cyanophenyl ester,
 55 20.0 o/o trans-4-butylcyclohexane carboxylic acid p-(ethoxy)phenyl ester, 55
 18.0 o/o trans-4-pentylcyclohexane carboxylic acid p-(methoxy)phenyl ester,
 7.0 o/o 4'-pentyl-4-cyano-p-terphenyl, and
 8.0 o/o trans-p-[5-(4-pentylcyclohexyl)-2-pyrimidinyl]-benzonitrile, melting point <0°C; clearing point 85°C.

Mixture 49:

- 17.5 o/o 4'-Heptyl-4-cyanobiphenyl,
 5.0 o/o p-(5-pentyl-2-pyrimidinyl)benzonitrile,
 9.0 o/o p-(5-heptyl-2-pyrimidinyl)benzonitrile,
 65 11.0 o/o trans-4-propylcyclohexane carboxylic acid p-cyanophenyl ester, 65

- 6.0 o/o trans-4-butylcyclohexane carboxylic acid p-cyanophenyl ester,
 9.0 o/o trans-4-pentylcyclohexane carboxylic acid p-cyanophenyl ester,
 15.5 o/o trans-4-pentylcyclohexane carboxylic acid p-(methoxy)phenyl ester,
 17.0 o/o trans-4-butylcyclohexane carboxylic acid p-(ethoxy)phenyl ester, and
 5 10.0 o/o trans-p-[5-(4-ethylcyclohexyl)-2-pyrimidinyl]-benzonitrile, melting point <0°C; clearing point 69°C. 5

Mixture 50:

- 23.0 o/o 4'-Heptyl-4-cyanobiphenyl,
 7.0 o/o p-(5-pentyl-2-pyrimidinyl)benzonitrile,
 10 12.0 o/o p-(5-heptyl-2-pyrimidinyl)benzonitrile, 10
 14.0 o/o trans-4-propylcyclohexane carboxylic acid p-cyanophenyl ester,
 12.0 o/o trans-4-pentylcyclohexane carboxylic acid p-cyanophenyl ester,
 20.0 o/o trans-4-pentylcyclohexane carboxylic acid p-(methoxy)phenyl ester, and
 12.0 o/o trans-p-[5-(4-ethylcyclohexyl)-2-pyrimidinyl]-benzonitrile, melting point <0°C; clearing point 70°C.

15 15

Mixture 51:

- 6.0 o/o p-Butylbenzoic acid p'-cyanophenyl ester,
 7.0 o/o p-(5-pentyl-2-pyrimidinyl)benzonitrile,
 12.0 o/o p-(5-heptyl-2-pyrimidinyl)benzonitrile,
 20 14.0 o/o trans-4-propylcyclohexane carboxylic acid p-cyanophenyl ester, 20
 8.0 o/o trans-4-butylcyclohexane carboxylic acid p-cyanophenyl ester,
 12.0 o/o trans-4-pentylcyclohexane carboxylic acid p-cyanophenyl ester,
 22.0 o/o trans-4-butylcyclohexane carboxylic acid p-(ethoxy)phenyl ester,
 8.0 o/o 4'-pentyl-4-cyano-p-terphenyl, and
 25 11.0 o/o trans-p-[5-(4-ethylcyclohexyl)-2-pyrimidinyl]-benzonitrile, melting point <0°C; clearing point 89°C. 25

Mixture 52:

- 18.0 o/o 4'-Heptyl-4-cyanobiphenyl,
 5.0 o/o p-butylbenzoic acid p'-cyanophenyl ester,
 30 5.0 o/o p-(5-pentyl-2-pyrimidinyl)benzonitrile, 30
 9.5 o/o p-(5-heptyl-2-pyrimidinyl)benzonitrile,
 11.0 o/o trans-4-propylcyclohexane carboxylic acid p-cyanophenyl ester,
 9.5 o/o trans-4-pentylcyclohexane carboxylic acid p-cyanophenyl ester,
 18.0 o/o trans-4-butylcyclohexane carboxylic acid p-(ethoxy)phenyl ester,
 35 10.0 o/o trans-p-[5-(4-ethylcyclohexyl)-2-pyrimidinyl]-benzonitrile and 35
 14.0 o/o trans-p-[5-(4-heptylcyclohexyl)-2-pyrimidinyl]benzonitrile, melting point <0°C; clearing point 93°C.

Mixture 53:

- 5.0 o/o p-Butylbenzoic acid p'-cyanophenyl ester, 40
 5.0 o/o p-(5-pentyl-2-pyrimidinyl)benzonitrile, 40
 10.0 o/o p-(5-heptyl-2-pyrimidinyl)benzonitrile,
 11.0 o/o trans-4-propylcyclohexane carboxylic acid p-cyanophenyl ester,
 10.0 o/o trans-4-pentylcyclohexane carboxylic acid p-cyanophenyl ester,
 45 18.0 o/o trans-4-butylcyclohexane carboxylic acid p-(ethoxy)phenyl ester, 45
 17.0 o/o trans-4-pentylcyclohexane carboxylic acid p-(methoxy)phenyl ester,
 10.0 o/o trans-p-[5-(4-ethylcyclohexyl)-2-pyrimidinyl]-benzonitrile, and
 14.0 o/o trans-p-[5-(4-heptylcyclohexyl)-2-pyrimidinyl]benzonitrile, melting point <0°C; clearing point 98°C.

50 50

Mixture 54:

- 15.0 o/o 4'-Heptyl-4-cyanobiphenyl,
 4.0 o/o p-butylbenzoic acid p'-cyanophenyl ester,
 4.5 o/o p-(5-pentyl-2-pyrimidinyl)benzonitrile,
 55 8.0 o/o p-(5-heptyl-2-pyrimidinyl)benzonitrile, 55
 9.5 o/o trans-4-propylcyclohexane carboxylic acid p-cyanophenyl ester,
 8.0 o/o trans-4-pentylcyclohexane carboxylic acid p-cyanophenyl ester,
 15.0 o/o trans-4-butylcyclohexane carboxylic acid p-(ethoxy)phenyl ester,
 14.0 o/o trans-4-pentylcyclohexane carboxylic acid p-(methoxy)phenyl ester,
 60 9.0 o/o trans-p-[5-(4-ethylcyclohexyl)-2-pyrimidinyl]-benzonitrile, and 60
 13.0 o/o trans-p-[5-(4-heptylcyclohexyl)-2-pyrimidinyl]benzonitrile, melting point <0°C; clearing point 92°C.

Mixture 55:

- 65 33.0 o/o 4'-Pentyl-4-cyanobiphenyl, 65

29

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	8.5 o/o trans-4-propylcyclohexane carboxylic acid p-cyanophenyl ester, 7.0 o/o trans-4-pentylcyclohexane carboxylic acid p-cyanophenyl ester, 14.0 o/o trans-4-butylcyclohexane carboxylic acid p-(ethoxy)phenyl ester, 12.5 o/o trans-4-pentylcyclohexane carboxylic acid p-(methoxy)phenyl ester, 5 8.0 o/o trans-p-[5-(4-ethylcyclohexyl)-2-pyrimidinyl]-benzonitrile, 5 5.0 o/o trans-p-[5-(4-pentylcyclohexyl)-2-pyrimidinyl]-benzonitrile, and 12.0 o/o trans-p-[5-(4-heptylcyclohexyl)-2-pyrimidinyl]benzonitrile, melting point <0°C; clearing point 96°C.	
10	Mixture 56:	10
	45.0 o/o 4'-Pentyl-4-cyanobiphenyl, 6.0 o/o p-butylbenzoic acid p'-cyanophenyl ester, 6.0 o/o p-(5-pentyl-2-pyrimidinyl)benzonitrile, 13.0 o/o trans-4-propylcyclohexane carboxylic acid p-cyanophenyl ester, 15 7.5 o/o trans-4-butylcyclohexane carboxylic acid p-cyanophenyl ester, 15 11.5 o/o trans-4-pentylcyclohexane carboxylic acid p-cyanophenyl ester, and 11.0 o/o trans-p-[5-(4-ethylcyclohexyl)-2-pyrimidinyl]-benzonitrile, melting point <0°C; clearing point 65°C.	
	Mixture 57:	
20	41.0 o/o 4'-Pentyl-4-cyanobiphenyl, 20 5.0 o/o p-Butylbenzoic acid p'-cyanophenyl ester, 5.0 o/o p-(5-pentyl-2-pyrimidinyl)benzonitrile, 12.0 o/o trans-4-propylcyclohexane carboxylic acid p-cyanophenyl ester, 10.0 o/o trans-4-pentylcyclohexane carboxylic acid p-cyanophenyl ester, 25 16.0 o/o trans-4-pentylcyclohexane carboxylic acid p-(methoxy)phenyl ester, and 25 11.0 o/o trans-p-[5-(4-ethylcyclohexyl)-2-pyrimidinyl]-benzonitrile, melting point <0°C; clearing point 65°C.	
	Mixture 58:	
30	29.0 o/o 4'-Heptyl-4-cyanobiphenyl, 30 8.0 o/o p-butylbenzoic acid p'-cyanophenyl ester, 8.0 o/o p-(5-pentyl-2-pyrimidinyl)benzonitrile, 17.0 o/o trans-4-propylcyclohexane carboxylic acid p-cyanophenyl ester, 10.0 o/o trans-4-butylcyclohexane carboxylic acid p-cyanophenyl ester, 35 15.0 o/o trans-4-pentylcyclohexane carboxylic acid p-cyanophenyl ester, and 35 13.0 o/o trans-p-[5-(4-ethylcyclohexyl)-2-pyrimidinyl]-benzonitrile, melting point <0°C; clearing point 73°C.	
	Mixture 59:	
40	21.0 o/o 4'-Heptyl-4-cyanobiphenyl, 40 5.0 o/o p-butylbenzoic acid p'-cyanophenyl ester, 6.0 o/o p-(5-pentyl-2-pyrimidinyl)benzonitrile, 11.0 o/o p-(5-heptyl-2-pyrimidinyl)benzonitrile, 13.0 o/o trans-4-propylcyclohexane carboxylic acid p-cyanophenyl ester, 11.0 o/o trans-4-pentylcyclohexane carboxylic acid p-cyanophenyl ester, 45 21.0 o/o trans-4-butylcyclohexane carboxylic acid p-(ethoxy)phenyl ester, and 45 12.0 o/o trans-p-[5-(4-ethylcyclohexyl)-2-pyrimidinyl]-benzonitrile, melting point <0°C; clearing point 71°C.	
	Mixture 60:	
50	37.0 o/o 4'-Pentyl-4-cyanobiphenyl, 50 5.0 o/o p-(5-pentyl-2-pyrimidinyl)benzonitrile, 8.0 o/o p-(5-heptyl-2-pyrimidinyl)benzonitrile, 28.0 o/o trans-p-(4-pentylcyclohexyl)benzonitrile, 9.0 o/o trans-p-[5-(4-ethylcyclohexyl)-2-pyrimidinyl]-benzonitrile, and 13.0 o/o trans-p-[5-(4-heptylcyclohexyl)-2-pyrimidinyl]benzonitrile, melting point <0°C; clearing point 55 84°C. 55	
	Mixture 61:	
60	3.5 o/o p-Butylbenzoic acid p'-cyanophenyl ester, 60 4.0 o/o p-(5-pentyl-2-pyrimidinyl)benzonitrile, 7.0 o/o p-(5-heptyl-2-pyrimidinyl)benzonitrile, 60 25.0 o/o trans-p-(4-pentylcyclohexyl)benzonitrile, 8.5 o/o trans-4-propylcyclohexane carboxylic acid p-cyanophenyl ester, 7.0 o/o trans-4-pentylcyclohexane carboxylic acid p-cyanophenyl ester, 13.0 o/o trans-4-butylcyclohexane carboxylic acid p-(ethoxy)phenyl ester, 65 12.0 o/o trans-4-pentylcyclohexane carboxylic acid p-(methoxy)phenyl ester, 65	

8.0 o/o trans-p-[5-(4-ethylcyclohexyl)-2-pyrimidinyl]-benzonitrile, and
12.0 o/o trans-p-[5-(4-heptylcyclohexyl)-2-pyrimidinyl]benzonitrile, melting point <0°C; clearing point 89°C.

5 **Mixture 62:**

- 37.0 o/o 4'-Pentyl-4-cyanobiphenyl, 5
21.0 o/o 4'-pentyloxy-4-cyanobiphenyl,
4.0 o/o p-butylbenzoic acid p'-cyanophenyl ester,
5.0 o/o p-(5-pentyl-2-pyrimidinyl)benzonitrile,
10 8.0 o/o p-(5-heptyl-2-pyrimidinyl)benzonitrile, 10
15.0 o/o trans-4-butylcyclohexane carboxylic acid p-(ethoxy)phenyl ester, and
10.0 o/o trans-p-[5-(4-ethylcyclohexyl)-2-pyrimidinyl]-benzonitrile, melting point <0°C; clearing point 65°C.

Mixture 63:

- 15 43.0 o/o 4'-Pentyl-4-cyanobiphenyl, 15
24.0 o/o 4'-Pentyloxy-4-cyanobiphenyl,
6.0 o/o p-(5-pentyl-2-pyrimidinyl)benzonitrile,
11.0 o/o p-(5-heptyl-2-pyrimidinyl)benzonitrile,
10.0 o/o trans-p-[5-(4-ethylcyclohexyl)-2-pyrimidinyl]-benzonitrile, and
20 6.0 o/o trans-p-[5-(4-butylcyclohexyl)-2-pyrimidinyl]-benzonitrile, melting point <0°C; clearing point 70°C. 20

Mixture 64:

- 44.0 o/o 4'-Pentyl-4-cyanobiphenyl,
21.0 o/o 4'-heptyl-4-cyanobiphenyl,
25 6.0 o/o p-(5-pentyl-2-pyrimidinyl)benzonitrile, 25
12.0 o/o p-(5-heptyl-2-pyrimidinyl)benzonitrile,
11.0 o/o trans-p-[5-(4-ethylcyclohexyl)-2-pyrimidinyl]-benzonitrile, and
6.0 o/o trans-p-[5-(4-butylcyclohexyl)-2-pyrimidinyl]-benzonitrile, melting point <0°C; clearing point 70°C.

30 **Mixture 65:**

- 41.0 o/o 4'-Pentyl-4-cyanobiphenyl, 30
19.0 o/o 4'-heptyl-4-cyanobiphenyl,
5.0 o/o p-(5-pentyl-2-pyrimidinyl)benzonitrile
10.0 o/o p-(5-heptyl-2-pyrimidinyl)benzonitrile,
35 18.0 o/o trans-4-butylcyclohexane carboxylic acid p-(ethoxy)phenyl ester, and 35
7.0 o/o trans-p-[5-(4-pentylcyclohexyl)-2-pyrimidinyl]-benzonitrile, melting point <0°C; clearing point 58°C.

Mixture 66:

- 40 47.0 o/o 4'-Pentyl-4-cyanobiphenyl, 40
23.0 o/o 4'-heptyl-4-cyanobiphenyl,
7.0 o/o p-(5-pentyl-2-pyrimidinyl)benzonitrile,
11.0 o/o p-(5-heptyl-2-pyrimidinyl)benzonitrile, and
12.0 o/o trans-p-[5-(4-ethylcyclohexyl)-2-pyrimidinyl]-benzonitrile, melting point <0°C; clearing point 60°C.

45 45

Mixture 67:

- 36.0 o/o 4'-Pentyl-4-cyanobiphenyl,
15.0 o/o 4'-heptyl-4-cyanobiphenyl,
5.0 o/o p-(5-pentyl-2-pyrimidinyl)benzonitrile,
50 8.0 o/o p-(5-heptyl-2-pyrimidinyl)benzonitrile, 50
15.0 o/o trans-4-butylcyclohexane carboxylic acid p-(ethoxy)phenyl ester,
14.0 o/o trans-4-pentylcyclohexane carboxylic acid p-(methoxy)phenyl ester, and
7.0 o/o trans-p-[5-(4-pentylcyclohexyl)-2-pyrimidinyl]-benzonitrile, melting point <0°C; clearing point 59°C.

55 55

Mixture 68:

- 55.0 o/o 4'-Pentyl-4-cyanobiphenyl,
11.0 o/o 4'-octyloxy-4-cyanobiphenyl,
9.0 o/o p-(5-pentyl-2-pyrimidinyl)benzonitrile,
60 16.0 o/o p-(5-heptyl-2-pyrimidinyl)benzonitrile, and 60
9.0 o/o trans-p-[5-(4-pentylcyclohexyl)-2-pyrimidinyl]-benzonitrile, melting point <0°C; clearing point 65°C.

Mixture 69:

- 65 40.0 o/o 4'-Pentyl-4-cyanobiphenyl, 65

23.0 o/o 4'-pentyloxy-4-cyanobiphenyl,
 5.0 o/o p-(5-pentyl-2-pyrimidinyl)benzonitrile,
 10.0 o/o p-(5-heptyl-2-pyrimidinyl)benzonitrile,
 16.0 o/o trans-4-pentylcyclohexane carboxylic acid p-(methoxy)phenyl ester, and
 5 6.0 o/o trans-p-[5-(4-pentylcyclohexyl)-2-pyrimidinyl]-benzonitrile, melting point <0°C; clearing point 62°C. 5

Mixture 70:

7.0 o/o 4'-Pentyl-4-cyanobiphenyl,
 10 5.6 o/o p-butylbenzoic acid p'-cyanophenyl ester, 10
 6.5 o/o p-(5-pentyl-2-pyrimidinyl)benzonitrile,
 12.1 o/o p-(5-heptyl-2-pyrimidinyl)benzonitrile,
 7.4 o/o trans-4-butylcyclohexane carboxylic acid p-cyanophenyl ester,
 11.2 o/o trans-4-pentylcyclohexane carboxylic acid p-cyanophenyl ester,
 15 20.4 o/o trans-4-butylcyclohexane carboxylic acid p-(ethoxy)phenyl ester, 15
 18.6 o/o trans-4-pentylcyclohexane carboxylic acid p-(methoxy)phenyl ester, and
 11.2 o/o trans-p-[5-(4-ethylcyclohexyl)-2-pyrimidinyl]-benzonitrile, melting point <0°C; clearing point 71°C.

Mixture 71:

20 31.0 o/o 4'-Pentyl-4-cyanobiphenyl, 20
 30.0 o/o p-[(p-hexylbenzyliden)amino]benzonitrile,
 12.0 o/o trans-4-butylcyclohexane carboxylic acid p-(ethoxy)phenyl ester,
 19.0 o/o trans-4-pentylcyclohexane carboxylic acid p-(propyloxy)phenyl ester, and
 8.0 o/o trans-p-[5-(4-ethylcyclohexyl)-2-pyrimidinyl]-benzonitrile, melting point <0°C; clearing point 66°C.

25 25

Mixture 72:

5.0 o/o p-Butylbenzoic acid p'-cyanophenyl ester,
 4.0 o/o p-pentylbenzoic acid p'-cyanophenyl ester,
 26.0 o/o p-[(p-butylbenzyliden)amino]benzonitrile,
 30 5.0 o/o p-(5-pentyl-2-pyrimidinyl)benzonitrile, 30
 10.0 o/o p-(5-heptyl-2-pyrimidinyl)benzonitrile,
 11.0 o/o trans-4-propylcyclohexane carboxylic acid p-cyanophenyl ester,
 10.0 o/o trans-4-pentylcyclohexane carboxylic acid p-cyanophenyl ester,
 19.0 o/o trans-4-butylcyclohexane carboxylic acid p-(ethoxy)phenyl ester, and
 35 10.0 o/o trans-p-[5-(4-ethylcyclohexyl)-2-pyrimidinyl]-benzonitrile, melting point <0°C; clearing point 73°C. 35

Mixture 73:

6.0 o/o 4'-Octyloxy-4-cyanobiphenyl,
 7.0 o/o p-butylbenzoic acid p'-cyanophenyl ester,
 40 6.0 o/o p-(5-pentyl-2-pyrimidinyl)benzonitrile, 40
 12.0 o/o p-(5-heptyl-2-pyrimidinyl)benzonitrile,
 12.0 o/o trans-4-propylcyclohexane carboxylic acid p-cyanophenyl ester,
 11.0 o/o trans-4-pentylcyclohexane carboxylic acid p-cyanophenyl ester,
 19.0 o/o trans-4-butylcyclohexane carboxylic acid p-(ethoxy)phenyl ester,
 45 18.0 o/o trans-4-pentylcyclohexane carboxylic acid p-(methoxy)phenyl ester, and 45
 9.0 o/o trans-p-[5-(4-ethylcyclohexyl)-2-pyrimidinyl]-benzonitrile, melting point <0°C; clearing point 71°C.

Mixture 74:

23.0 o/o 4'-Heptyl-4-cyanobiphenyl,
 50 21.0 o/o trans-4-butylcyclohexane carboxylic acid p-(ethoxy)phenyl ester, 50
 19.0 o/o trans-4-pentylcyclohexane carboxylic acid p-(methoxy)phenyl ester,
 26.0 o/o trans-4-pentylcyclohexane carboxylic acid p-(propyloxy)phenyl ester, and
 11.0 o/o trans-p-[5-(4-ethylcyclohexyl)-2-pyrimidinyl]-benzonitrile, melting point <0°C; clearing point 73°C.

55 Mixture 75: 55

75.0 wt.% mixture 74 and
 25.0 wt.% mixture 47,
 melting point <0°C; clearing point 71.9°C.

60 Mixture 76: 60

60.0 wt.% mixture 74 and
 40.0 wt.% mixture 47,
 melting point <0°C; clearing point 71.7°C.

Mixture 77:

45.0 wt.% mixture 74 and
55.0 wt.% mixture 47,
melting point $<0^{\circ}\text{C}$; clearing point 71.8°C .

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5

Mixture 78:

15.0 wt.% mixture 74 and
85.0 wt.% mixture 47,
melting point $<0^{\circ}\text{C}$; clearing point 72.4°C .

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Mixture 79:

75.0 wt.% mixture 74 and
25.0 wt.% mixture 70,
melting point $<0^{\circ}\text{C}$; clearing point 71.5°C .

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Mixture 80:

15.0 wt.% mixture 74 and
85.0 wt.% mixture 70,
melting point $<0^{\circ}\text{C}$; clearing point 70.6°C .

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20

Mixture 81:

22.0 o/o 4'-Heptyl-4-cyanobiphenyl,
13.0 o/o trans-4-propylcyclohexane carboxylic acid p-cyanophenyl ester,
21.0 o/o trans-4-butylcyclohexane carboxylic acid p-(ethoxy)phenyl ester,
19.0 o/o trans-4-pentylcyclohexane carboxylic acid p-(methoxy)phenyl ester,
18.0 o/o trans-4-pentylcyclohexane carboxylic acid p-(propyloxy)phenyl ester, and
7.0 o/o trans-p-[5-(4-pentylcyclohexyl)-2-pyrimidinyl]-benzonitrile, melting point $<0^{\circ}\text{C}$; clearing point 71.6°C .

25

25

Mixture 82:

Mixture 55 + colouring substance of formula IXa in which R^8 represents a n-heptyl group; melting point $<0^{\circ}\text{C}$; clearing point 97°C ; blue; $\lambda_{\text{max}} = 594 \text{ nm}$; $\text{S} = 0.745$.

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Mixture 83:

Mixture 46 + colouring substance of formula IXa in which R^8 represents a n-heptyl group; melting point $<0^{\circ}\text{C}$; clearing point 96°C ; blue; $\lambda_{\text{max}} = 594 \text{ nm}$; $\text{S} = 0.707$.

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Mixture 84:

Mixture 47 + colouring substance of formula IXa in which R^8 represents a n-heptyl group; melting point $<0^{\circ}\text{C}$; clearing point 73°C ; blue; $\lambda_{\text{max}} = 594 \text{ nm}$; $\text{S} = 0.717$.

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Mixture 85:

Mixture 53 + colouring substance of formula IXa in which R^8 represents a n-butyl group; melting point $<0^{\circ}\text{C}$; clearing point 98°C ; blue; $\lambda_{\text{max}} = 594 \text{ nm}$; $\text{S} = 0.709$.

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Mixture 86:

Mixture 53 + colouring substance of formula IXa in which R^8 represents a methyl group; melting point $<0^{\circ}\text{C}$; clearing point 98°C ; blue; $\lambda_{\text{max}} = 594 \text{ nm}$; $\text{S} = 0.694$.

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Mixture 87:

Mixture 31 + colouring substance of formula IXa in which R^8 represents a n-heptyl group; melting point $<0^{\circ}\text{C}$; clearing point 102°C ; blue; $\lambda_{\text{max}} = 594 \text{ nm}$; $\text{S} = 0.768$.

Mixture 88:

Mixture 46 + colouring substance of formula VIIa in which X^7 represents a n-butyloxy group, Z^3 represents a dimethylamino group and n_4 stands for zero; melting point $<0^{\circ}\text{C}$; clearing point 97°C ; red; $\lambda_{\text{max}} = 509 \text{ nm}$; $\text{S} = 0.683$.

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55

Mixture 89:

Mixture 55 + colouring substance of formula VIIa in which X^7 represents an ethoxy group, Z^3 represents a dimethylamino group and n_4 stands for zero; melting point $<0^{\circ}\text{C}$; clearing point 97°C ; red; $\lambda_{\text{max}} = 514 \text{ nm}$.

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60

Mixture 90:

Mixture 55 + colouring substance of formula XI in which R^4 represents an ethyl group; melting point $<0^{\circ}\text{C}$; clearing point 97°C ; yellow; $\lambda_{\text{max}} = 446 \text{ nm}$; $\text{S} = 0.889$.

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65

Mixture 91:

Mixture 55 + colouring substance of formula IVa; melting point $<0^{\circ}\text{C}$; clearing point 97°C ; yellow-red; $\lambda_{\text{max}} = 500 \text{ nm}$; $S = 0.817$.

5 Mixture 92:

Mixture 55 + colouring substance of formula VIIa in which X^7 represents a nitro group, Z^3 represents a diethylamino group and n_4 stands for 1; melting point $<0^{\circ}\text{C}$; clearing point 97°C ; steel blue; $\lambda_{\text{max}} = 605 \text{ nm}$; $S = 0.816$.

10 Mixture 93:

Mixture 55 + colouring substance of formula XII in which R^5 represents an ethyl group; melting point $<0^{\circ}\text{C}$; clearing point 97°C ; blue; $\lambda_{\text{max}} = 636 \text{ nm}$; $S = 0.716$.

Mixture 94:

- 15 35.0 o/o 4'-Pentyl-4-cyanobiphenyl, 15
 4.0 o/o p-butylbenzoic acid p'-cyanophenyl ester,
 4.0 o/o p-pentylbenzoic acid p'-cyanophenyl ester,
 4.0 o/o p-(5-pentyl-2-pyrimidinyl)benzonitrile,
 8.0 o/o p-(5-heptyl-2-pyrimidinyl)benzonitrile,
 20 9.0 o/o trans-4-propylcyclohexane carboxylic acid p-cyanophenyl ester, 20
 8.0 o/o trans-4-pentylcyclohexane carboxylic acid p-cyanophenyl ester,
 19.0 o/o trans-4-pentylcyclohexane carboxylic acid p-(propyloxy)phenyl ester, and
 9.0 o/o trans-p-[5-(4-ethylcyclohexyl)-2-pyrimidinyl]-benzonitrile, melting point $<0^{\circ}\text{C}$; clearing point 63°C .

25 Mixture 95:

- 25 33.0 o/o 4'-Pentyl-4-cyanobiphenyl, 25
 30.0 o/o 4'-hexyl-4-cyanobiphenyl,
 5.0 o/o 4'-octyloxy-4-cyanophenyl,
 4.0 o/o p-(5-pentyl-2-pyrimidinyl)benzonitrile
 30 8.0 o/o p-(5-heptyl-2-pyrimidinyl)benzonitrile, 30
 3.0 o/o p-butylbenzoic acid p'-cyanophenyl ester,
 7.0 o/o trans-4-pentylcyclohexane carboxylic acid p-cyanophenyl ester, and
 10.0 o/o trans-p-[5-(4-ethylcyclohexyl)-2-pyrimidinyl]-benzonitrile, melting point $<0^{\circ}\text{C}$; clearing point 58°C .

35 Mixture 96:

- 35 25.5 o/o 4'-Heptyl-4-cyanobiphenyl, 35
 13.0 o/o p-[(p-propylbenzyliden)amino]benzonitrile,
 7.0 o/o p-butylbenzoic acid p'-cyanophenyl ester,
 6.0 o/o p-pentylbenzoic acid p'-cyanophenyl ester,
 40 7.5 o/o p-(5-pentyl-2-pyrimidinyl)benzonitrile, 40
 14.0 o/o p-(5-heptyl-2-pyrimidinyl)benzonitrile,
 15.0 o/o trans-4-propylcyclohexane carboxylic acid p-cyanophenyl ester, and
 12.0 o/o trans-p-[5-(4-ethylcyclohexyl)-2-pyrimidinyl]-benzonitrile, melting point $<0^{\circ}\text{C}$; clearing point 70°C .

For mixtures which contain colouring substances there also come into consideration other liquid crystal matrices insofar as the clearing points are higher than about 80°C . Preferred liquid crystal matrices for mixtures which contain colouring substances are mixtures 2, 15, 24, 25, 27, 31, 39-42, 46-48, 52-55 and 61 hereinbefore.

The following Examples illustrate the process provided by the present invention:

50 Example 1

- 50 9.5 ml of benzenesulphonyl chloride are added dropwise while stirring to a suspension of 17.2 g of crude 50
 trans-p-[5-(4-n-pentylcyclohexyl)-2-pyrimidinyl]benzamide in 150 ml of pyridine. The mixture is then
 warmed to 55°C for 6 hours in an oil-bath. The mixture is poured into 500 ml of ice-cold 0.5-N hydrochloric
 acid and the product is taken up in methylene chloride. The extract is washed three times with 200 ml of 3-N
 55 hydrochloric acid each time, then with 100 ml of saturated sodium bicarbonate solution and with water, 55
 dried over sodium sulphate and evaporated. The crude product is chromatographed on a column of 600 g of
 silica gel with toluene/5% acetone (v/v). The fractions which are pure according to thin-layer chromatogra-
 phy are dissolved in hexane, filtered hot with active carbon and recrystallised. There is obtained
 trans-p-[5-(4-n-pentylcyclohexyl)-2-pyrimidinyl]benzonitrile; melting point 100.5°C , clearing point 231°C .
 60 The trans-p-[5-(4-n-pentylcyclohexyl)-2-pyrimidinyl]-benzamide used as the starting material can be 60
 prepared as follows:

- a) A solution of 63.9 g of trans-4-n-pentylcyclohexane carboxylic acid in 250 ml of dry ether is added
 dropwise to a suspension of 12.2 g of lithium aluminium hydride in 1000 ml of dry ether in such a manner
 that the mixture boils slightly. After completion of the dropwise addition, the mixture is stirred for a further 1
 65 hour. There are then cautiously added dropwise 80 ml of ethyl acetate and thereafter 100 ml of ice-water. The 65

reaction mixture is poured into ice-water and made Congo acid with dilute hydrochloric acid. The organic phase is separated, washed in sequence with water, sodium bicarbonate solution and water, dried over sodium sulphate and evaporated. The resulting trans-4-n-pentylcyclohexane carbinol is used in the next step without purification.

- 5 b) A solution of 59.0 g of trans-4-n-pentylcyclohexane carbinol in 100 ml of ether is added to a suspension of 125 g of pyridinium chlorochromate in 900 ml of methylene chloride and the mixture is stirred at room temperature for 2 hours. The mixture is then diluted with 400 ml of ether, stirred for a further 15 minutes and the solution is decanted off from the tarry precipitate. The precipitate is back-washed with ether. The combined organic solutions are filtered through a Florisil column. The trans-4-n-pentyl-cyclohexane carboxaldehyde obtained after evaporation of the filtrate is used directly in the next step.

*Florisil is a registered Trade Mark.

- 10 c) A suspension of 223.1 g of (methoxymethyl)triphenyl-phosphonium chloride in 1600 ml of dry ether is treated with 76.2 of potassium tert.butylate. After stirring for 45 minutes, a solution of 51.4 g of trans-4-n-pentylcyclohexane carboxaldehyde in 300 ml of ether is added dropwise. The mixture is stirred for a further 2 hours and then poured into 2.5 litres of ice-water. The organic phase is separated, washed neutral with water, dried over sodium sulphate and evaporated. The resulting crude trans-2-(4-n-pentylcyclohexyl)vinyl methyl ether is distilled at 92°-96°C/0.7 mm Hg in order to separate the residual triphenyl-phosphine.

- 15 d) 38.7 g of trans-2-(4-n-pentylcyclohexyl)vinyl methyl ether are added dropwise while stirring to a solution, cooled to 0°C, of 13.1 g of boron trifluoride diethyl etherate in 700 ml of freshly distilled triethyl orthoformate and the mixture is stirred at room temperature overnight. The mixture is then diluted with 1000 ml of toluene, washed neutral with 200 ml of sodium bicarbonate solution and then with water, dried over sodium sulphate, filtered and evaporated. The crude trans-(4-n-pentylcyclohexyl)malonic bis-acetal is used in the next step without further purification.

- 20 e) 57.4 g of crude trans-(4-n-pentylcyclohexyl)malonic bis-acetal are treated with 3.5 ml of water and 150 mg of p-toluenesulphonic acid. The mixture is stirred at 80°-85°C for 3 hours. The mixture is then left to cool, 1.6 g of sodium bicarbonate are added and the resulting mixture is stirred at room temperature for 1.5 hours. The mixture is diluted with ether, washed with three 50 ml portions of ice-cold 3-N sodium hydroxide, washed neutral with water, dried over sodium sulphate, filtered and evaporated. The crude 3-ethoxy-2-(trans-4-n-pentylcyclohexyl)acrolein is used immediately in the next step.

- 25 f) A sodium methylate solution is prepared by the cautious addition of 4.8 g of sodium in small portions to 175 ml of absolute methanol. 17.8 g of 3-ethoxy-2-(trans-4-n-pentylcyclohexyl)acrolein are added dropwise to the sodium methylate solution while stirring, the mixture is stirred for a further 10 minutes and then 16.2 g of p-carbamoylbenzamide hydrochloride are added thereto. The mixture is stirred at 50°C overnight. After cooling, the mixture is acidified with 55 ml of 3-N hydrochloric acid. The suspension is filtered under suction, the residue is washed on the filter with water, sucked dry and dried at 70°C in a water-jet vacuum. The brownish crude trans-p-[5-(4-n-pentylcyclohexyl)-2-pyrimidinyl]benzamide is used in the process described in the first paragraph of this Example without purification.

The following pyrimidine derivatives of formula I can be manufactured in an analogous manner:

- 30 Trans-p-[5-(4-methylcyclohexyl)-2-pyrimidinyl]benzonitrile; melting point 150.5°C, clearing point 213.5°C; trans-p-[5-(4-ethylcyclohexyl)-2-pyrimidinyl]benzonitrile; melting point 118°C, clearing point 225°C; trans-p-[5-(4-n-propylcyclohexyl)-2-pyrimidinyl]benzonitrile; melting point 122.5°C, clearing point 243.5°C; trans-p-[5-(4-n-butylcyclohexyl)-2-pyrimidinyl]benzonitrile; melting point 118°C, clearing point 234°C; trans-p-[5-(4-n-hexylcyclohexyl)-2-pyrimidinyl]benzonitrile; melting point 91.5°C, clearing point 224.5°C; 35 trans-p-[5-(4-n-heptylcyclohexyl)-2-pyrimidinyl]benzonitrile; melting point 80.5°C, clearing point 219°C; (+)-trans-p-[5-[4-(2-methylbutyl)cyclohexyl]-2-pyrimidinyl]benzonitrile; $\alpha_D = +9$, melting point 76°C, smectic-cholesteric phase transition 125°C, clearing point 178°C; and (+)-trans-p-[5-[4-(3-methylpentyl)cyclohexyl]-2-pyrimidinyl]benzonitrile; $\alpha_D = +7$, melting point 101°C, smectic-cholesteric phase transition 159°C, clearing point 189.5°C.

50

Example 2

- 6.0 ml of benzenesulphonyl chloride are added dropwise while stirring to a suspension of 10.8 g of trans-4-[5-(p-n-heptylphenyl)-2-pyrimidinyl]cyclohexane carboxamide in 150 ml of pyridine. The mixture is then warmed to 55°C for 2 hours in an oil-bath. The mixture is poured into ice-water and the product is taken up in methylene chloride. The extract is washed successively with dilute hydrochloric acid, saturated sodium bicarbonate solution and water, dried over sodium sulphate and evaporated. The crude product is chromatographed on a column of 300 g of silica gel with toluene/5% acetone (v/v). The fractions which are pure according to thin-layer chromatography are combined and evaporated. The residue is dissolved in hexane, filtered hot with active carbon and recrystallised. The crystallisate is dried in vacuo overnight. There is obtained trans-4-[5-(p-n-heptylphenyl)-2-pyrimidinyl]cyclohexane carbonitrile; melting point 83.5°C, clearing point 160°C.

The trans-4-[5-(p-n-heptylphenyl)-2-pyrimidinyl]cyclohexane carboxamide used as the starting material can be prepared as follows:

- 65 a) 96.6 g of trans-4-cyanocyclohexane carboxylic acid methyl ester are dissolved under an inert gas in 130 ml of absolute methanol and 150 ml of dry benzene. Dry hydrogen chloride is conducted in at 0°C while



stirring until the solution is saturated. The colourless solution is stirred overnight, whereby the product, trans-4-carbomethoxycyclohexane-carbimide acid methyl ester hydrochloride, begins to crystallise out. The mixture is left to stand for a further 3 days and then the precipitated iminoester hydrochloride is filtered off.

100.7 g of the precipitated crude product suspended in 150 ml of methanol are, after cooling to ca -40°C,

5 treated with 70 g of liquid ammonia and shaken at +70°C for 24 hours in an autoclave. After cooling the reaction mixture to room temperature and discharging the excess ammonia, the suspension is evaporated, the solid product is washed several times on the filter with ether and the residue remaining behind is recrystallised from methanol to give trans-4-carbamoylcyclohexane-carboxamide hydrochloride.

b) To a sodium methylate solution prepared by the addition of 3.2 g of sodium to 125 ml of methanol are 10 added 12.6 g of 3-ethoxy-2-(p-n-heptylphenyl)acrolein and then 9.9 g of trans-4-carbamoylcyclohexane-carboxamide hydrochloride. The mixture is stirred at 50°C overnight. The mixture is then acidified with dilute hydrochloric acid and the suspension is filtered. The residue is washed neutral and dried in vacuo. For purification, the residue is boiled with ether. There is obtained trans-4-[5-(p-n-heptylphenyl)-2-pyridimidinyl]cyclohexane carboxamide which is difficultly soluble.

15 The following pyrimidine derivatives of formula I can be manufactured in an analogous manner:

Trans-4-[5-(p-methylphenyl)-2-pyrimidinyl]cyclohexane carbonitrile;

trans-4-[5-(p-ethylphenyl)-2-pyrimidinyl]cyclohexane carbonitrile; melting point 172°C, clearing point 197.5°C;

trans-4-[5-(p-propylphenyl)-2-pyrimidinyl]cyclohexane carbonitrile; melting point 146°C, clearing point 194.5°C;

20 trans-4-[5-(p-butylphenyl)-2-pyrimidinyl]cyclohexane carbonitrile; melting point 139.5°C, clearing point 179.5°C;

trans-4-[5-(p-pentylphenyl)-2-pyrimidinyl]cyclohexane carbonitrile; melting point 112°C, clearing point 175.5°C;

25 trans-4-[5-(p-hexylphenyl)-2-pyrimidinyl]cyclohexane carbonitrile; melting point 84°C, clearing point 163°C; and

trans-4-[5-(p-octylphenyl)-2-pyrimidinyl]cyclohexane carbonitrile; melting point 82.5°C, clearing point 152.5°C.

30 Example 3

7.2 ml of benzenesulphonyl chloride are added dropwise while stirring to a suspension of 13.2 g of crude trans-4-[5-(trans-4-n-pentylcyclohexyl)-2-pyrimidinyl]cyclohexane carboxamide in 150 ml of pyridine. The mixture is then warmed to 55°C for 3 hours in an oil-bath. The mixture is poured into 500 ml of ice-water and the product is taken up in methylene chloride. The extract is washed successively with 3-N hydrochloric acid, 35 saturated sodium bicarbonate solution and water, dried over sodium sulphate and evaporated. The crude product is chromatographed on a column of 500 g of silica gel with toluene/5% acetone (v/v). The first fractions are mixtures and are discarded. The later fractions, which are uniform according to thin-layer chromatography, are dissolved in hexane, filtered hot with active carbon and recrystallised from the filtrate. There is obtained pure trans-4-[5-(trans-4-n-pentylcyclohexyl)-2-pyrimidinyl]cyclohexane carbonitrile; melt- 40 ing point 109.5°C, clearing point 175°C.

The trans-4-[5-(trans-4-n-pentylcyclohexyl)-2-pyrimidinyl]cyclohexane carboxamide used as the starting material can be prepared as follows:

16.0 g of 3-ethoxy-2-(trans-4-n-pentylcyclohexyl)-acrolein (prepared as described in Example 1) are added dropwise while stirring to a sodium methylate solution prepared by the addition of 4.4 g of sodium to 175 ml 45 of methanol and then 15.0 g of trans-4-carbamoylcyclohexane-carboxamide hydrochloride (prepared as described in Example 2) are added thereto. The mixture is stirred at 50°C overnight. The mixture is then acidified with dilute hydrochloric acid. The suspension is filtered. The residue is washed neutral with water and dried in vacuo. The resulting crude trans-4-[5-(trans-4-n-pentylcyclohexyl)-2-pyrimidinyl]cyclohexane carboxamide is used directly in the process described in the first paragraph of this Example.

50 The following pyrimidine derivatives of formula I can be manufactured in an analogous manner:

Trans-4-[5-(trans-4-methylcyclohexyl)-2-pyrimidinyl]-cyclohexane carbonitrile;

trans-4-[5-(trans-4-ethylcyclohexyl)-2-pyrimidinyl]-cyclohexane carbonitrile; melting point 166.5°C, clearing point 161°C;

trans-4-[5-(trans-4-propylcyclohexyl)-2-pyrimidinyl]-cyclohexane carbonitrile; melting point 132°C, clearing point 184°C;

55 trans-4-[5-(trans-4-butylcyclohexyl)-2-pyrimidinyl]-cyclohexane carbonitrile; melting point 121°C, clearing point 172°C;

trans-4-[5-(trans-4-hexylcyclohexyl)-2-pyrimidinyl]-cyclohexane carbonitrile;

trans-4-[5-(trans-4-heptylcyclohexyl)-2-pyrimidinyl]-cyclohexane carbonitrile; melting point 102.5°C, clearing point 163.5°C;

60 (+)-trans-4-[5-[trans-(2-methylbutyl)cyclohexyl]-2-pyrimidinyl]cyclohexane carbonitrile; $\alpha_D = +10$; melting point 124°C; clearing point 125°C; and

(+)-trans-4-[5-[trans-(3-methylpentyl)cyclohexyl]-2-pyrimidinyl]cyclohexane carbonitrile; $\alpha_D = +7$; melting point 138°C, clearing point 134°C.

Example 4

9.2 ml of benzenesulphonyl chloride are added dropwise while stirring to a suspension of 16.0 g of trans-p-[5-(4-n-propyloxycyclohexyl)-2-pyrimidinyl]benzamide in 170 ml of pyridine. The mixture is then warmed to 40°C for 15 hours in an oil-bath. The clear mixture is poured into a mixture of 200 g of ice and 24.1 ml of concentrated hydrochloric acid and the product is taken up in methylene chloride. The extract is washed three times with 195 ml of 3-N hydrochloric acid each time, then with 100 ml of saturated sodium bicarbonate solution and with water, dried over sodium sulphate and evaporated. The crude product is chromatographed on a column of 200 g of silica gel with benzene and with benzene containing 1% and 2% acetone (v/v). The fractions which are pure according to thin-layer chromatography are recrystallised from acetone/hexane. There is obtained trans-p-[5-(4-n-propyloxycyclohexyl)-2-pyrimidinyl]-benzonitrile; melting point 114.5°C, clearing point 223.5°C.

The trans-p-[5-(4-n-propyloxy-cyclohexyl)-2-pyrimidinyl]benzamide used as the starting material can be prepared as follows:

a) A solution of 41.0 g of trans-4-n-propyloxycyclohexane carboxylic acid in 90 ml of dry ether is added dropwise to a suspension of 8.4 g of lithium aluminium hydride in 390 ml of dry ether so that the mixture boils slightly. After completion of the dropwise addition, the mixture is stirred for a further 1 hour. There are then cautiously added dropwise 22 ml of acetone and thereafter 35 ml of water. The mixture is poured into ice-water and made Congo acid with 280 ml of 3-N hydrochloric acid. The organic phase is separated, washed in sequence with water, sodium hydrogen carbonate solution and water, dried over sodium sulphate and evaporated. The trans-4-n-propyloxycyclohexane carbinol obtained is used in the next step without purification.

b) A solution of 38.6 g of trans-4-n-propyloxycyclohexane carbinol in 70 ml of methylene chloride is added to a suspension of 85.9 g of pyridinium chlorochromate in 620 ml of methylene chloride and the mixture is stirred at room temperature for 2.5 hours. The mixture is then diluted with 275 ml of ether, stirred for a further 15 minutes and the solution is decanted off from tarry precipitate. The precipitate is back-washed with ether. The combined organic solutions are filtered through a column of 175 g of Florisil. The trans-4-n-propyloxycyclohexane carboxaldehyde obtained after evaporation of the filtrate is used directly in the next step.

c) A suspension of 94.6 g of (methoxymethyl)triphenyl-phosphonium chloride in 1000 ml of dry ether is treated with 33.0 g of potassium tert.butylate. After stirring for 45 minutes, a solution of 31.4 g of trans-4-n-propyloxy-cyclohexane carboxaldehyde in 200 ml of ether is added dropwise. The mixture is stirred for a further 2.5 hours and then poured into 1.2 litres of ice-water. The organic phase is separated, washed neutral with water, dried over sodium sulphate and evaporated. The crude trans-2-(4-n-propyloxycyclohexyl)vinyl methyl ether obtained is distilled at 82°-85°C/0.6 mmHg in order to separate the residual triphenylphosphine.

d) 28.0 g of trans-2-(4-n-propyloxycyclohexyl)vinyl methyl ether are added dropwise while stirring to a solution, cooled to 0°C, 8.9 ml of boron trifluoride diethyl etherate in 535 ml of freshly distilled triethyl orthoformate and the mixture is stirred at room temperature overnight. The mixture is then diluted with 735 ml of toluene, washed and 155 ml of sodium bicarbonate solution and then with water, dried over sodium sulphate, filtered and evaporated. The crude trans-(4-n-propyloxycyclohexyl)-malonic bis-acetal is used in the next step without further purification.

e) 49.0 g of crude trans-(4-n-propyloxycyclohexyl)malonic bis-acetal are treated with 3.1 ml of water and 132 mg of p-toluenesulphonic acid. The mixture is stirred at 85°C for 2 hours. The mixture is then left to cool, 1.4 g of sodium hydrogen carbonate are added and the resulting mixture is stirred at room temperature for 1.5 hours. The mixture is diluted with ether, washed with three 44 ml portions of ice-cold 3-N sodium hydroxide each time and then with water, dried over sodium sulphate, filtered and evaporated. The crude 3-ethoxy-2-(trans-4-n-propyloxycyclohexyl)acrolein is used immediately in the next step.

f) A sodium methylate solution is prepared from 9.7 g of sodium and 392 ml of absolute methanol. At room temperature there are added while stirring 31.4 g of p-carbamoyl-benzamidine hydrochloride and then 29.8 g of 3-ethoxy-2-(trans-4-n-propyloxycyclohexyl)acrolein dissolved in 100 ml of absolute methanol. The mixture is stirred at 50°C overnight while gassing with nitrogen, the yellow suspension is left to cool to room temperature and is then acidified with 131 ml of 3-N hydrochloric acid. The suspension is filtered under suction and the precipitate is washed neutral with water and dried. For purification, the yellowish crude trans-p-[5-(4-n-propyloxycyclohexyl)-2-pyrimidinyl]benzamide is recrystallised from dioxan; melting point 261°-264°C (decomposition).

The following pyrimidine derivatives of formula I can be manufactured in an analogous manner:

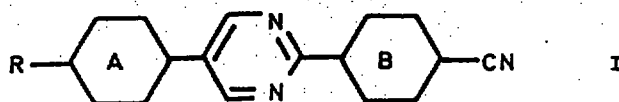
Trans-p-[5-(4-ethoxycyclohexyl)-2-pyrimidinyl]benzonitrile; melting point 144.5°C, clearing point 232°C; and

trans-p-[5-(4-pentyloxycyclohexyl)-2-pyrimidinyl]-benzonitrile; melting point 93°C, clearing point 205°C.



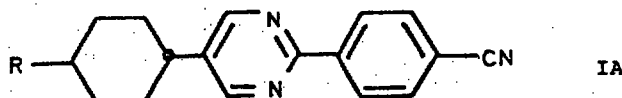
CLAIMS

1. Pyrimidine derivatives of the general formula



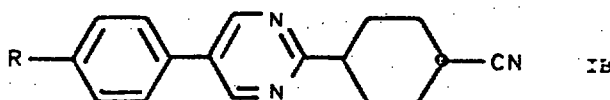
10 wherein at least one of the rings A and B represents a trans-1,4-disubstituted cyclohexane ring and the other is optionally aromatic and R represents a straight-chain alkyl or alkoxy group containing 1 to 10 carbon atoms or a branched-chain alkyl group of the formula $C_2H_5-CH(CH_3)-(CH_2)_n$ in which n stands for 1, 2 or 3.

2. Trans-p-[5-(4-alkyl- or 4-n-alkoxycyclohexyl)-2-pyrimidinyl]benzonitriles of the general formula



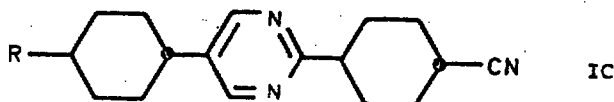
20 wherein R represents a straight-chain alkyl group containing 2 to 8 carbon atoms, a straight-chain alkoxy group containing up to 6 carbon atoms or a branched-chain alkyl group of the formula $C_2H_5-CH(CH_3)-(CH_2)_n$ in which n stands for 1, 2 or 3.

3. Trans-4-[5-(p-alkyl- or p-n-alkoxyphenyl)-2-pyrimidinyl]cyclohexane carbonitriles of the general formula



30 wherein R represents a straight-chain alkyl group containing 2 to 8 carbon atoms, a straight-chain alkoxy group containing up to 6 carbon atoms or branched-chain alkyl group of the formula $C_2H_5-CH(CH_3)-(CH_2)_n$ in which n stands for 1, 2 or 3.

4. Trans-4-[5-(trans-4-alkyl- or trans-4-n-alkoxy-cyclohexyl)-2-pyrimidinyl]cyclohexane carbonitriles of the general formula



40 wherein R represents a straight-chain alkyl group containing 2 to 8 carbon atoms, a straight-chain alkoxy group containing up to 6 carbon atoms or a branched-chain alkyl group of the formula $C_2H_5-CH(CH_3)-(CH_2)_n$ in which n stands for 1, 2 or 3.

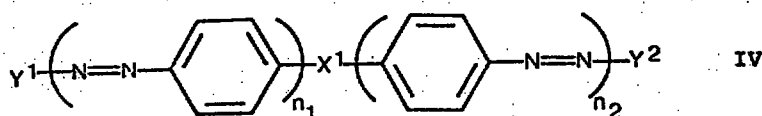
5. Trans-p-[5-(4-ethylcyclohexyl)-2-pyrimidinyl]benzonitrile.

6. Trans-p-[5-(4-pentylcyclohexyl)-2-pyrimidinyl]benzonitrile.

7. Trans-p-[5-(4-heptylcyclohexyl)-2-pyrimidinyl]benzonitrile.

45 8. A liquid crystalline mixture which contains one or more of the pyrimidine derivatives of formula I given in claim 1 and, if desired, other nematic and/or non-nematic compounds and/or more dichroic colouring substances.

50 9. A liquid crystalline mixture according to claim 8 which contains one or more of the pyrimidine derivatives of formula I given in claim 1 and one or more colouring substances of the general formulae:



60 wherein n_1 and n_2 stand for zero, 1 or 2, X^1 represents an azo or azoxy group, Y^1 and Y^2 , which can be the



* C L M S *

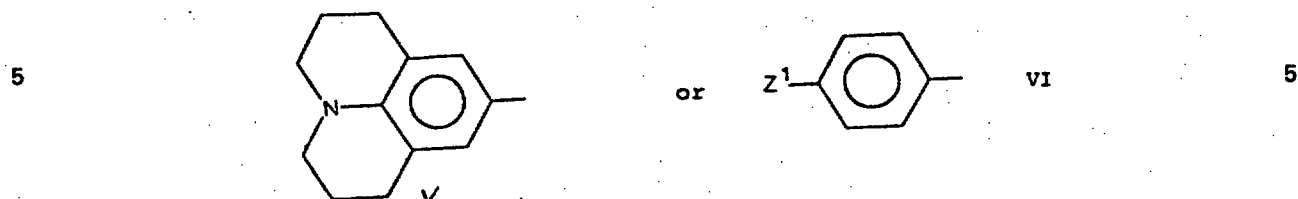
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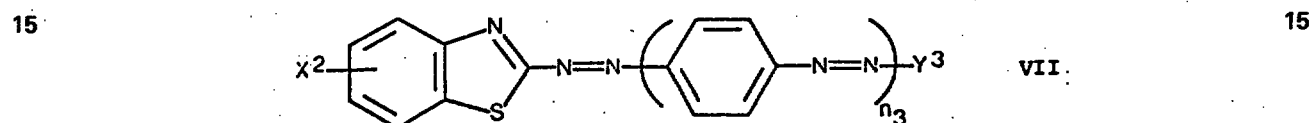
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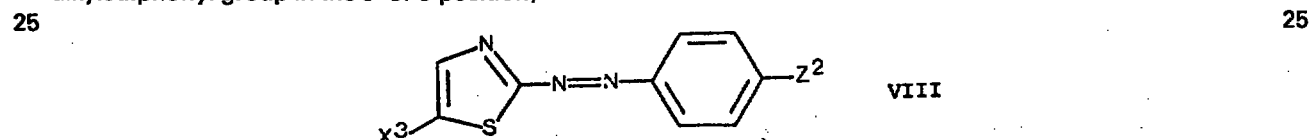
same or different, represent one of the groups



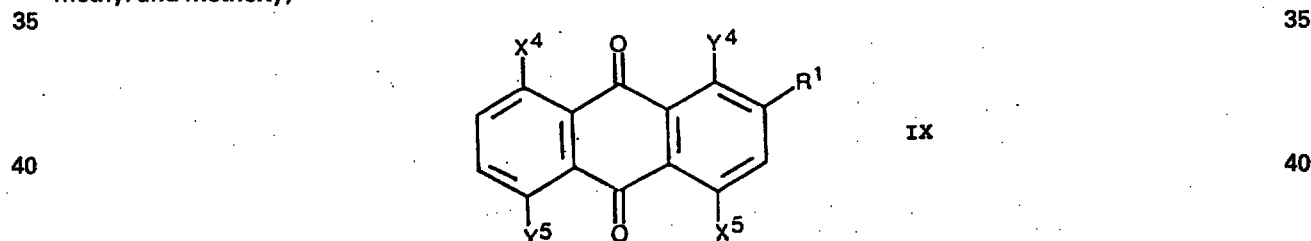
10 and Z¹ represents a hydrogen atom or a cyano, nitro, phenyl, p-substituted phenyl, hydroxy, alkoxy, amino, dialkylamino or pyrrolidyl group; or derivatives of formula IV in which one of the benzene rings additionally carries one or more substituents selected from halogen, methyl, halo-substituted methyl and methoxy;



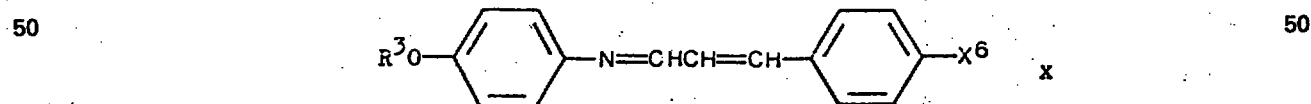
20 wherein n₃ stands for zero or 1, Y³ represents a group of formula V or VI given earlier in this claim, in which Z¹ represents a dialkylamino or pyrrolidyl group, and X² represents a hydrogen or halogen atom or a cyano, nitro, alkyl, alkoxy, optionally substituted phenyl, optionally substituted benzothiazol-2-yl, alkoxycarbonyl or alkylsulphonyl group in the 5- or 6-position;



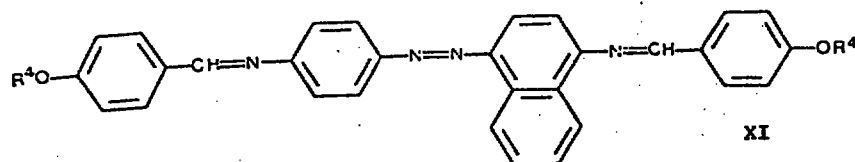
30 wherein X³ represents a cyano, nitro or alkyl group and Z² represents a hydroxy, alkoxy, aryl or optionally alkyl-substituted or aryl-substituted amino, pyrrolidyl or piperidyl group; or derivatives of formula VIII in which the benzene ring additionally carries one or more substituents selected from halogen, hydroxy, methyl and methoxy;



40 wherein X⁴ and X⁵ each represent a hydroxy group, Y⁴ and Y⁵ each represent an amino group and R¹ represents a group of formula VI given earlier in this claim or X⁴, Y⁴ and R¹ each represent a hydrogen atom, X⁵ represents a hydroxy group and Y⁴ represents the group -NHR² or X⁴, X⁵ and R¹ each represent a hydrogen atom and Y⁴ and Y⁵ each represent the group -NHR², R² representing a group of formula VI given earlier in this claim in which Z¹ represents an alkyl, alkoxy or dialkylamino group;



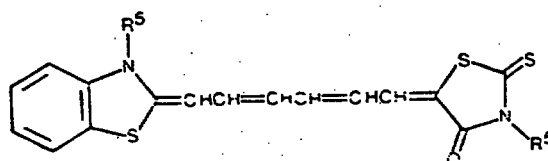
55 wherein R³ represents an alkyl group and X⁶ represents a cyano or nitro group;
or





wherein R^4 represents an alkyl group;
or.

5



XII

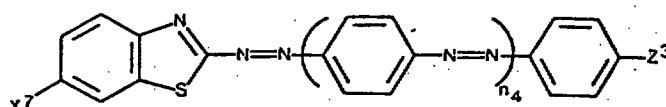
5

10 wherein R^5 represents an alkyl group;
and, if desired, other nematic and/or non-nematic compounds.

10

10. A liquid crystalline mixture according to claim 9 which contains at least one colouring substance of the formula

15



VIIa

15

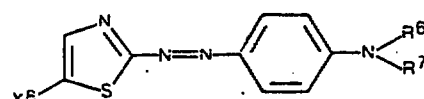
20

wherein n_4 stands for zero or 1, Z^3 represents a dimethylamino or diethylamino group and X^7 represents a hydrogen atom or a methyl, ethoxy, n-butyloxy, nitro or n-butylsulphonyl group.

20

11. A liquid crystalline mixture according to claim 9 which contains at least one colouring substance of the formula

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VIIIa

25

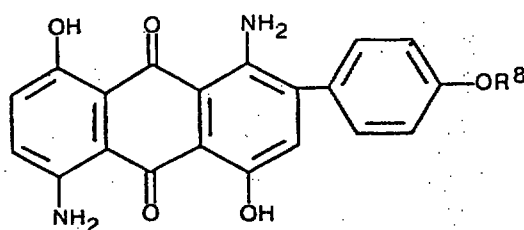
30

wherein R^6 , R^7 and X^8 each represent a methyl group or R^6 represents a methyl group, X^8 represents a nitro group and R^7 represents a methyl, phenyl or p-n-butyl-phenyl group.

30

12. A liquid crystalline mixture according to claim 9 which contains at least one colouring substance of the formula

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IXa

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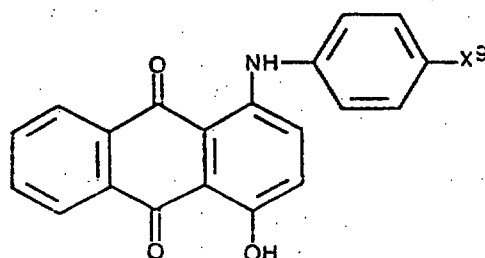
45

wherein R^8 represents a n-alkyl group containing 1 to 10 carbon atoms.

45

13. A liquid crystalline mixture according to claim 9 which contains at least one colouring substance of the formula

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IXb

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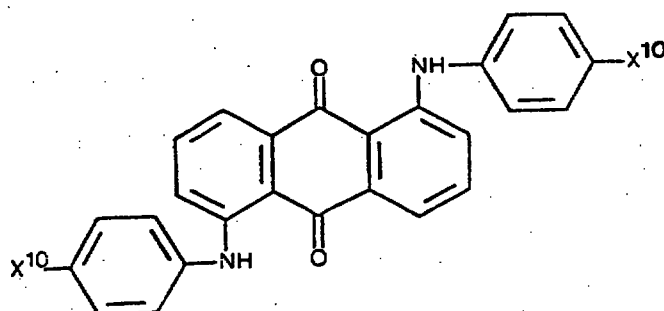
60

wherein X^9 represents a n-butyl, n-nonyloxy or dimethylamino group.

60



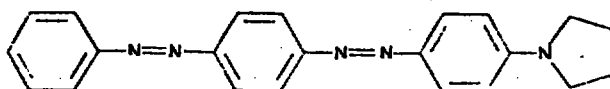
14. A liquid crystalline mixture according to claim 9 which contains at least one colouring substance of the formula



IXc

wherein X^{10} represents an ethyl, n-butyl, isopropyl, pentyloxy or dimethylamino group.

15. A liquid crystalline mixture according to claim 9 which contains the colouring substance of the formula



IVa

and/or the colouring substance of formula X in which R^3 represents a n-butyl group and X^6 represents a nitro group, and/or the colouring substance of formula XI in which R^4 represents an ethyl group, and/or the colouring substance of formula XII in which R^5 represents an ethyl group.

16. A liquid crystalline mixture according to claim 8 which contains 4'-penty-4-cyanobiphenyl, trans-4-propylcyclohexane carboxylic acid p-cyanophenyl ester, trans-4-pentylcyclohexane carboxylic acid p-cyanophenyl ester, trans-4-pentylcyclohexane carboxylic acid p-(methoxy)phenyl ester, trans-p-[5-(4-ethylcyclohexyl)-2-pyrimidinyl]-benzonitrile, trans-p-[5-(4-pentylcyclohexyl)-2-pyrimidinyl]-benzonitrile and trans-p-[5-(4-heptylcyclohexyl)-2-pyrimidinyl]benzonitrile.

17. A liquid crystalline mixture according to claim 8 which contains p-butylbenzoic acid p'-cyophenyl ester, p-(5-pentyl-2-pyrimidinyl)benzonitrile, p-(5-heptyl-2-pyrimidinyl)benzonitrile, trans-4-butylcyclohexane carboxylic acid p-cyanophenyl ester, trans-4-pentylcyclohexane carboxylic acid p-cyanophenyl ester, trans-4-butylcyclohexane carboxylic acid p-(ethoxy)phenyl ester, trans-4-pentylcyclohexane carboxylic acid p-(methoxy)phenyl ester and trans-p-[5-(4-ethylcyclohexyl)-2-pyrimidinyl]benzonitrile.

18. A liquid crystalline mixture according to claim 8 which contains p-butylbenzoic acid p'-cyanophenyl ester, p-(5-pentyl-2-pyrimidinyl)benzonitrile, p-(5-heptyl-2-pyrimidinyl)benzonitrile, trans-4-propylcyclohexane carboxylic acid p-cyanophenyl ester, trans-4-pentylcyclohexane carboxylic acid p-cyanophenyl ester, trans-4-butylcyclohexane carboxylic acid p-(ethoxy)phenyl ester, trans-4-pentylcyclohexane carboxylic acid p-(methoxy)phenyl ester, trans-p-[5-(4-pentylcyclohexyl)-2-pyrimidinyl]benzonitrile and trans-p-[5-(4-heptylcyclohexyl)-2-pyrimidinyl]benzonitrile.

19. A liquid crystalline mixture according to claim 8 which contains p-butylbenzoic acid p'-cyanophenyl ester, p-(5-pentyl-2-pyrimidinyl)benzonitrile, p-(5-heptyl-2-pyrimidinyl)benzonitrile, trans-4-propylcyclohexane carboxylic acid p-cyanophenyl ester, trans-4-butylcyclohexane carboxylic acid p-(ethoxy)phenyl ester, trans-4-pentylcyclohexane carboxylic acid p-(methoxy)phenyl ester and trans-p-[5-(4-ethylcyclohexyl)-2-pyrimidinyl]benzonitrile.

20. A liquid crystalline mixture according to claim 8 which contains 4'-heptyl-4-cyanobiphenyl, p-(5-pentyl-2-pyrimidinyl)benzonitrile, p-(5-heptyl-2-pyrimidinyl)benzonitrile, trans-4-propylcyclohexane carboxylic acid p-cyanophenyl ester, trans-4-butylcyclohexane carboxylic acid p-cyanophenyl ester, trans-4-pentylcyclohexane carboxylic acid p-cyanophenyl ester, trans-4-pentylcyclohexane carboxylic acid p-(methoxy)phenyl ester, trans-4-butylcyclohexane carboxylic acid p-(ethoxy)phenyl ester and trans-p-[5-(4-ethylcyclohexyl)-2-pyrimidinyl]benzonitrile.

21. A liquid crystalline mixture according to claim 8 which contains p-butylbenzoic acid p'-cyanophenyl ester, p-(5-pentyl-2-pyrimidinyl)benzonitrile, p-(5-heptyl-2-pyrimidinyl)benzonitrile, trans-4-propylcyclohexane carboxylic acid p-cyanophenyl ester, trans-4-butylcyclohexane carboxylic acid p-cyanophenyl ester, trans-4-pentylcyclohexane carboxylic acid p-cyanophenyl ester, trans-4-butylcyclohexane carboxylic acid p-(ethoxy)phenyl ester, 4'-penty-4-cyano-p-terphenyl and trans-p-[5-(4-ethylcyclohexyl)-2-pyrimidinyl]benzonitrile.

22. A liquid crystalline mixture according to claim 8 which contains 4'-penty-4-cyanobiphenyl, trans-4-propylcyclohexane carboxylic acid p-cyanophenyl ester, trans-4-pentylcyclohexane carboxylic acid p-cyanophenyl ester, trans-4-butylcyclohexane carboxylic acid p-(ethoxy)phenyl ester, trans-4-pentylcyclohexane carboxylic acid p-(methoxy)phenyl ester, trans-p-[5-(4-ethylcyclohexyl)-2-pyrimidinyl]-



benzonitrile, trans-p-[5-(4-pentylcyclohexyl)-2-pyrimidinyl]-benzonitrile and trans-p-[5-(4-heptylcyclohexyl)-2-pyrimidinyl]benzonitrile.

23. A liquid crystalline mixture according to claim 8 which contains 4'-pentyl-4-cyanobiphenyl, p-butylbenzoic acid p'-cyanophenyl ester, p-(5-pentyl-2-pyrimidinyl)benzonitrile, trans-4-propylcyclohexane carboxylic acid p-cyanophenyl ester, trans-4-pentylcyclohexane carboxylic acid p-cyanophenyl ester, trans-4-pentylcyclohexane carboxylic acid p-(methoxy)phenyl ester and trans-p-[5-(4-ethylcyclohexyl)-2-pyrimidinyl]benzonitrile.

24. A liquid crystalline mixture according to claim 8 which contains 4'-heptyl-4-cyanobiphenyl, p-butylbenzoic acid p'-cyanophenyl ester, p-(5-pentyl-2-pyrimidinyl)benzonitrile, p-(5-heptyl-2-pyrimidinyl)benzonitrile, trans-4-propylcyclohexane carboxylic acid p-cyanophenyl ester, trans-4-pentylcyclohexane carboxylic acid p-cyanophenyl ester, trans-4-butylcyclohexane carboxylic acid p-(ethoxy)-phenyl ester and trans-p-[5-(4-ethylcyclohexyl)-2-pyrimidinyl]benzonitrile.

25. A liquid crystalline mixture according to claim 8 which contains 4'-pentyl-4-cyanobiphenyl, 4'-heptyl-4-cyanobiphenyl, p-(5-pentyl-2-pyrimidinyl)benzonitrile, p-(5-heptyl-2-pyrimidinyl)benzonitrile, trans-4-butylcyclohexane carboxylic acid p-(ethoxy)phenyl ester and trans-p-[5-(4-pentylcyclohexyl)-2-pyrimidinyl]benzonitrile.

26. A liquid crystalline mixture according to claim 8 which contains 4'-pentyl-4-cyanobiphenyl, 4'-heptyl-4-cyanobiphenyl, p-(5-pentyl-2-pyrimidinyl)benzonitrile, p-(5-heptyl-2-pyrimidinyl)benzonitrile and trans-p-[5-(4-ethylcyclohexyl)-2-pyrimidinyl]benzonitrile.

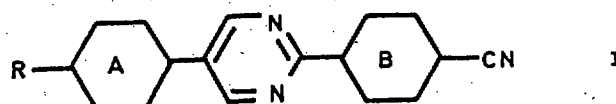
27. A liquid crystalline mixture according to claim 8 which contains 4'-pentyl-4-cyanobiphenyl, 4'-heptyl-4-cyanobiphenyl, p-(5-pentyl-2-pyrimidinyl)benzonitrile, p-(5-heptyl-2-pyrimidinyl)benzonitrile, trans-4-butylcyclohexane carboxylic acid p-(ethoxy)phenyl ester, trans-4-pentylcyclohexane carboxylic acid p-(methoxy)phenyl ester and trans-p-[5-(4-pentylcyclohexyl)-2-pyrimidinyl]benzonitrile.

28. A liquid crystalline mixture according to claim 8 which contains 4'-pentyl-4-cyanobiphenyl, 4'-octyloxy-4-cyanobiphenyl, p-(5-pentyl-2-pyrimidinyl)benzonitrile, p-(5-heptyl-2-pyrimidinyl)benzonitrile and trans-p-[5-(4-pentylcyclohexyl)-2-pyrimidinyl]benzonitrile.

29. A liquid crystalline mixture according to claim 8 which contains 4'-pentyl-4-cyanobiphenyl, p-butylbenzoic acid p'-cyanophenyl ester, p-(5-pentyl-2-pyrimidinyl)benzonitrile, p-(5-heptyl-2-pyrimidinyl)benzonitrile, trans-4-butylcyclohexane carboxylic acid p-cyanophenyl ester, trans-4-pentylcyclohexane carboxylic acid p-cyanophenyl ester, trans-4-butylcyclohexane carboxylic acid p-(ethoxy)phenyl ester, trans-4-pentylcyclohexane carboxylic acid p-(methoxy)-phenyl ester and trans-p-[5-(4-ethylcyclohexyl)-2-pyrimidinyl]benzonitrile.

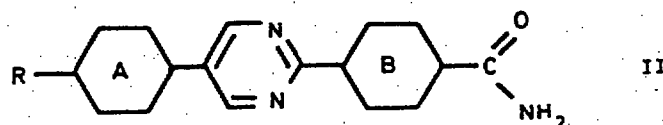
30. A liquid crystalline mixture according to claim 8 which contains 4'-heptyl-4-cyanobiphenyl, trans-4-propylcyclohexane carboxylic acid p-cyanophenyl ester, trans-4-butylcyclohexane carboxylic acid p-(ethoxy)phenyl ester, trans-4-pentylcyclohexane carboxylic acid p-(methoxy)phenyl ester, trans-4-pentylcyclohexane carboxylic acid p-(propyloxy)phenyl ester and trans-p-[5-(4-pentylcyclohexyl)-2-pyrimidinyl]benzonitrile.

31. A process for the manufacture of pyrimidine derivatives of the general formula



, wherein at least one of the rings A and B represents a trans-1,4-disubstituted cyclohexane ring and the other is optionally aromatic and R represents a straight-chain alkyl or alkoxy group containing 1 to 10 carbon atoms or a branched-chain alkyl group of the formula $C_2H_5-CH(CH_3)-(CH_2)_n-$ in which n stands for 1, 2 or 3, which process comprises

a) dehydrating a compound of the general formula



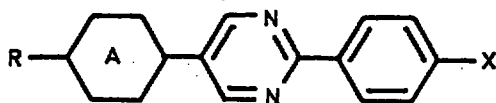
, wherein A, B and R have the significance given earlier in this claim, or



42

b) for the manufacture of a pyrimidine derivative of formula I in which the ring B is aromatic, reacting a compound of the general formula

5



III

5

10 , wherein R and A have the significance given earlier in this claim and X represents a fluorine, chlorine or bromine atom,
with copper(II) cyanide, sodium cyanide or potassium cyanide.

10

32. A process for the preparation of liquid crystalline mixtures, which process comprises mixing one or more of the pyrimidine derivatives of formula I given in claim 1 with other nematic and/or non-nematic compounds and/or with one or more dichroic colouring substances.

15

33. A process for the manufacture of an electro-optical apparatus, which process comprises introducing one or more of the pyrimidine derivatives of formula I given in claim 1, if desired in admixture with other nematic and/or non-nematic compounds and/or one or more dichroic colouring substances into a suitable cell.

20 34. The use of the pyrimidine derivatives of formula I given in claim 1 for electro-optical purposes.

20

35. An electro-optical apparatus containing one or more of the pyrimidine derivatives of formula I given in claim 1 in liquid-crystalline condition.

36. Pyrimidine derivatives according to any one of claims 1 to 7 for use in electro-optical apparatuses.