

PATENT SPECIFICATION

(11) 1 473 990

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- (21) Application No. 43822/75 (22) Filed 24 Oct. 1975
 (31) Convention Application No. 14313/74
 (32) Filed 25 Oct. 1974 in
 (33) Switzerland (CH)
 (44) Complete Specification published 18 May 1977
 (51) INT CL² C07D 239/24; C09K 3/34/C07C 47/26, 63/52, 69/96, 121/00, 123/00



(52) Index at acceptance

C2C 1600 1601 200 20Y 215 220 226 227 22Y 246 248 250
 252 25Y 270 271 280 292 29X 29Y 305 30Y 313 316
 31Y 320 326 328 337 339 342 34Y 350 351 352
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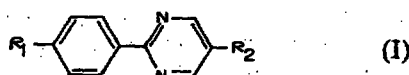
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(54) PHENYL-PYRIMIDINES

(71) We, R. HOFFMANN LA ROCHE & CO., AKTIENGESELLSCHAFT, a Swiss Company of 124-184 Grenzacherstrasse, Basle, Switzerland, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:-

The present invention relates to phenyl-pyrimidines. More particularly, the invention is concerned with phenyl-pyrimidines, a process for the manufacture thereof, nematic mixtures for electro-optical purposes containing same and a process for the production of said nematic mixtures. The invention is also concerned with an electro-optical apparatus containing said phenyl-pyrimidines.

The phenyl-pyrimidines provided by the present invention have the following general formula



wherein one of the symbols R₁ and R₂ represents the cyano group and the other represents a straight-chain alkyl group containing 3 to 9 carbon atoms, a straight-chain alkoxy group containing 2 to 9 carbon atoms or a straight-chain alkanoyloxy group containing 2 to 9 carbon atoms.

The phenyl-pyrimidines of formula I hereinbefore are especially valuable as components of liquid crystalline mixtures and, for the most part, themselves possess liquid crystalline properties and, in particular, nematic properties. The present phenyl-pyrimidines 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).

In an electric field, the phenyl-pyrimidines 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 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)] as well as in the Kerr cell described in Molecular Crystals and Liquid Crystals 17 355 (1972).

The electro-optical rotation cell is essentially a condenser having transparent

electrodes whose dielectric is formed from a nematic substance with $\epsilon_{||} > \epsilon_{\perp}$. The longitudinal axes of the molecules of the liquid crystal are arranged in twisted form between the condenser plates in the fieldless state, the twisting structure being defined by the given wall orientation of the molecules. After the application of an electrical 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. A cell of this type is hereinafter referred to as a "rotation cell".

In such a "rotation cell", it is desirable to use compounds or mixtures which possess a low threshold. A low threshold is of considerable advantage for applications in which a small volume and a low energy requirement is of particular importance; for example, when a rotation cell is used in watches or pocket calculators.

It has now been found that the phenyl-pyrimidines of formula I possess a particularly low threshold. Moreover, they have not only the necessary large positive anisotropy of the dielectric constants and a low threshold, but show a slight viscosity, a high response rate and a high stability, especially in the form of their mixtures with one another or with other nematic or non-nematic substances. The operation of electro-optical devices is accordingly possible using a lower voltage, shorter response time and, because of their high stability, with easier handling. A further advantage of the phenyl-pyrimidines of formula I which possess nematic properties is that such phenyl-pyrimidines form colourless nematic phases.

The following phenyl-pyrimidines fall within the scope of formula I hereinbefore:

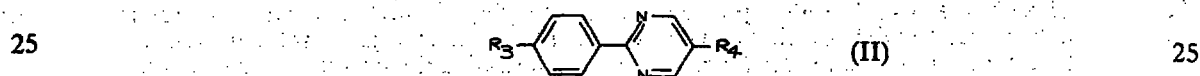
5-n-propyl-2-(4-cyanophenyl)-pyrimidine,
 5-n-butyl-2-(4-cyanophenyl)-pyrimidine,
 5-n-pentyl-2-(4-cyanophenyl)-pyrimidine,
 5-n-hexyl-2-(4-cyanophenyl)-pyrimidine,
 5-n-heptyl-2-(4-cyanophenyl)-pyrimidine,
 5-n-octyl-2-(4-cyanophenyl)-pyrimidine,
 5-n-nonyl-2-(4-cyanophenyl)-pyrimidine,
 5-ethoxy-2-(4-cyanophenyl)-pyrimidine,
 5-n-propoxy-2-(4-cyanophenyl)-pyrimidine,
 5-n-butoxy-2-(4-cyanophenyl)-pyrimidine,
 5-n-pentyloxy-2-(4-cyanophenyl)-pyrimidine,
 5-n-hexyloxy-2-(4-cyanophenyl)-pyrimidine,
 5-n-heptyloxy-2-(4-cyanophenyl)-pyrimidine,
 5-n-octyloxy-2-(4-cyanophenyl)-pyrimidine,
 5-n-nonyloxy-2-(4-cyanophenyl)-pyrimidine,
 5-acetoxy-2-(4-cyanophenyl)-pyrimidine,
 5-n-propionyloxy-2-(4-cyanophenyl)-pyrimidine,
 5-n-butyryloxy-2-(4-cyanophenyl)-pyrimidine,
 5-n-valeryloxy-2-(4-cyanophenyl)-pyrimidine,
 5-n-hexanoyloxy-2-(4-cyanophenyl)-pyrimidine,
 5-n-heptanoyloxy-2-(4-cyanophenyl)-pyrimidine,
 5-n-octanoyloxy-2-(4-cyanophenyl)-pyrimidine,
 5-n-nonanoyloxy-2-(4-cyanophenyl)-pyrimidine,
 5-cyano-2-(4-n-propylphenyl)-pyrimidine,
 5-cyano-2-(4-n-butylphenyl)-pyrimidine,
 5-cyano-2-(4-n-pentylphenyl)-pyrimidine,
 5-cyano-2-(4-n-hexylphenyl)-pyrimidine,
 5-cyano-2-(4-n-heptylphenyl)-pyrimidine,
 5-cyano-2-(4-n-octylphenyl)-pyrimidine,
 5-cyano-2-(4-n-nonylphenyl)-pyrimidine,
 5-cyano-2-(4-ethoxyphenyl)-pyrimidine,
 5-cyano-2-(4-n-propoxyphenyl)-pyrimidine,
 5-cyano-2-(4-n-butoxyphenyl)-pyrimidine,
 5-cyano-2-(4-n-pentyloxyphenyl)-pyrimidine,
 5-cyano-2-(4-n-hexyloxyphenyl)-pyrimidine,
 5-cyano-2-(4-n-heptyloxyphenyl)-pyrimidine,

- 5-cyano-2-(4-n-octyloxyphenyl)-pyrimidine,
 5-cyano-2-(4-n-nonyloxyphenyl)-pyrimidine,
 5-cyano-2-(4-acetoxyphenyl)-pyrimidine,
 5-cyano-2-(4-n-propionyloxyphenyl)-pyrimidine,
 5-cyano-2-(4-n-butyryloxyphenyl)-pyrimidine,
 5-cyano-2-(4-n-valeryloxyphenyl)-pyrimidine,
 5-cyano-2-(4-n-hexanoyloxyphenyl)-pyrimidine,
 5-cyano-2-(4-n-heptanoyloxyphenyl)-pyrimidine,
 5-cyano-2-(4-n-octanoyloxyphenyl)-pyrimidine and
 5-cyano-2-(4-n-nonanoyloxyphenyl)-pyrimidine.

Amongst the phenyl-pyrimidines of formula I, there are especially preferred those in which one of the symbols R_1 and R_2 represents the cyano group and the other represents a straight-chain alkyl group containing 5 to 7 carbon atoms or a straight-chain alkoxy group containing 4 to 6 carbon atoms. More especially preferred are:

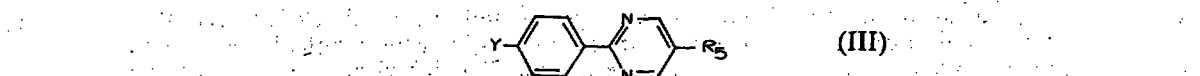
- 5-n-heptyl-2-(4-cyanophenyl)-pyrimidine,
 5-n-pentyl-2-(4-cyanophenyl)-pyrimidine,
 5-cyano-2-(4-n-pentylphenyl)-pyrimidine,
 5-cyano-2-(4-n-hexylphenyl)-pyrimidine,
 5-cyano-2-(4-n-butyloxyphenyl)-pyrimidine and
 5-cyano-2-(4-n-pentyloxyphenyl)-pyrimidine.

According to the process provided by the present invention, the phenyl-pyrimidines of formula I hereinbefore are manufactured by
 (a) dehydrating a compound of the general formula



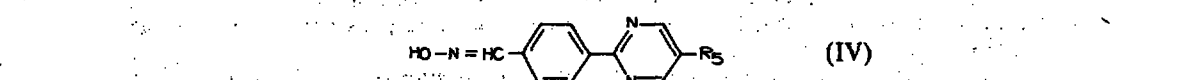
wherein one of the symbols R_3 and R_4 represents a straight-chain alkyl group containing 3 to 9 carbon atoms, a straight-chain alkoxy group containing 2 to 9 carbon atoms or a straight-chain alkanoyloxy group containing 2 to 9 carbon atoms and the other represents the aminocarbonyl group,
 or

(b) for the manufacture of phenyl-pyrimidines of formula I wherein R_1 represents the cyano group and R_2 represents a straight-chain alkyl group containing 3 to 9 carbon atoms, a straight-chain alkoxy group containing 2 to 9 carbon atoms or a straight-chain alkanoyloxy group containing 2 to 9 carbon atoms, reacting a compound of the general formula



wherein R_5 represents a straight-chain alkyl group containing 3 to 9 carbon atoms, a straight-chain alkoxy group containing 2 to 9 carbon atoms or a straight-chain alkanoyloxy group containing 2 to 9 carbon atoms and Y represents a halogen atom or an arylsulphonyloxy group,
 with copper (I) cyanide or sodium cyanide,
 or

(c) for the manufacture of phenyl-pyrimidines of formula I wherein R_1 represents the cyano group and R_2 represents a straight-chain alkyl group containing 3 to 9 carbon atoms, a straight-chain alkoxy group containing 2 to 9 carbon atoms or a straight-chain alkanoyloxy group containing 2 to 9 carbon atoms, dehydrating a compound of the general formula



wherein R_5 has the significance given earlier,
 or

(d) for the manufacture of phenyl-pyrimidines of formula I wherein R_1

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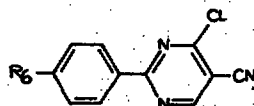
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represents a straight-chain alkyl group containing 3 to 9 carbon atoms, a straight-chain alkoxy group containing 2 to 9 carbon atoms or a straight-chain alkanoyloxy group containing 2 to 9 carbon atoms and R_2 represents the cyano group, reductively dehalogenating a compound of the general formula

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(V)

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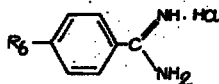
wherein R_6 represents a straight-chain alkyl group containing 3 to 9 carbon atoms, a straight-chain alkoxy group containing 2 to 9 carbon atoms or a straight-chain alkanoyloxy group containing 2 to 9 carbon atoms, or

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(e) for the manufacture of phenyl-pyrimidines of formula I wherein R_1 represents a straight-chain alkyl group containing 3 to 9 carbon atoms, a straight-chain alkoxy group containing 2 to 9 carbon atoms or a straight-chain alkanoyloxy group containing 2 to 9 carbon atoms and R_2 represents the cyano group, reacting a compound of the general formula

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(VI)

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wherein R_6 has the significance given earlier, with an alkali salt of acetalised hydroxymethylene-cyanacetaldehyde.

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In one aspect of the process, a compound of formula II is dehydrated. This dehydration can be carried out using any suitable dehydrating agent such as phosphorus oxychloride, phosphorus pentoxide, thionyl chloride or acetic anhydride. The dehydration can be carried out in an inert organic solvent such as a hydrocarbon or halogenated hydrocarbon, if desired in the presence of a base such as sodium acetate, pyridine or triethanolamine. The dehydration can, however, also be carried out in the absence of an organic solvent. The dehydration may be carried out at the reflux temperature of the mixture. The pressure is not critical; it is, however, advantageous to carry out the dehydration at atmospheric pressure.

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In another aspect of the process, a compound of formula III is reacted with copper (I) cyanide or sodium cyanide. This reaction is conveniently carried out in an inert organic solvent such as ethylene glycol, tetrahydrofuran, dimethylformamide, dimethyl sulphoxide, pyridine or acetonitrile. The temperature and pressure of the reaction are not critical; it is expedient to carry out the reaction at atmospheric pressure and at a temperature between room temperature and the reflux temperature of the mixture. In the compound of formula III, Y is preferably a halogen atom, especially bromine.

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In a further aspect of the process, a compound of formula IV is dehydrated. This dehydration is conveniently carried out using acetic anhydride or with anhydrous sodium acetate in glacial acetic acid. The dehydration may be carried out at the reflux temperature of the mixture. The pressure is not critical; it is advantageous, however, to carry out the dehydration at atmospheric pressure.

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In yet another aspect of the process, a compound of formula V is reductively dehalogenated. This dehalogenation is advantageously carried out using zinc dust in a mixture of dioxane and water. The dehalogenation preferably takes place at the reflux temperature of the dehalogenation mixture. The pressure is not critical; it is advantageous, however, to carry out the dehalogenation at atmospheric pressure.

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In still further aspect of the process, a compound of formula VI is reacted with an alkali salt of acetalised hydroxymethylene-cyanacetaldehyde. An aqueous solution of the compound of formula VI may be used and, after reaction, the mixture may be made slightly acidic. The mixture may then be evaporated and the residue treated with acetic anhydride. The reaction is preferably carried out at a temperature between room temperature and 100°C. The pressure is not critical; atmospheric pressure is preferred.

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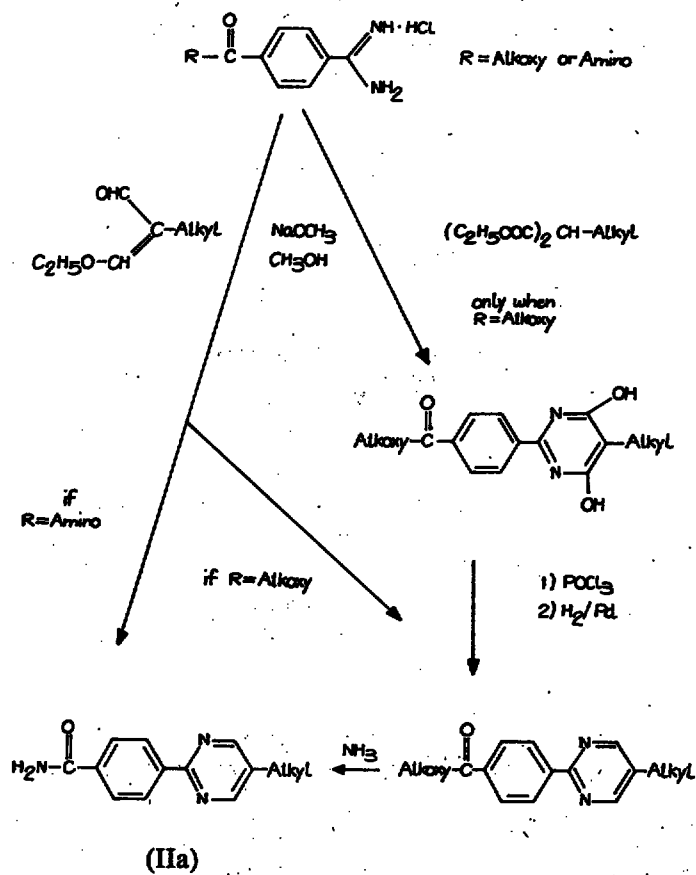
The preparation of the starting materials of formulae II, III, IV, V and VI, in which one of the symbols R_1 and R_2 or R_3 and R_4 represents a straight-chain alkyl group containing 3 to 9 carbon atoms, is illustrated in Formula Schemes A to E hereinafter. In these Formula Schemes, the term "alkyl" represents a straight-chain alkyl group containing 3 to 9 carbon atoms.

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Formula Scheme A



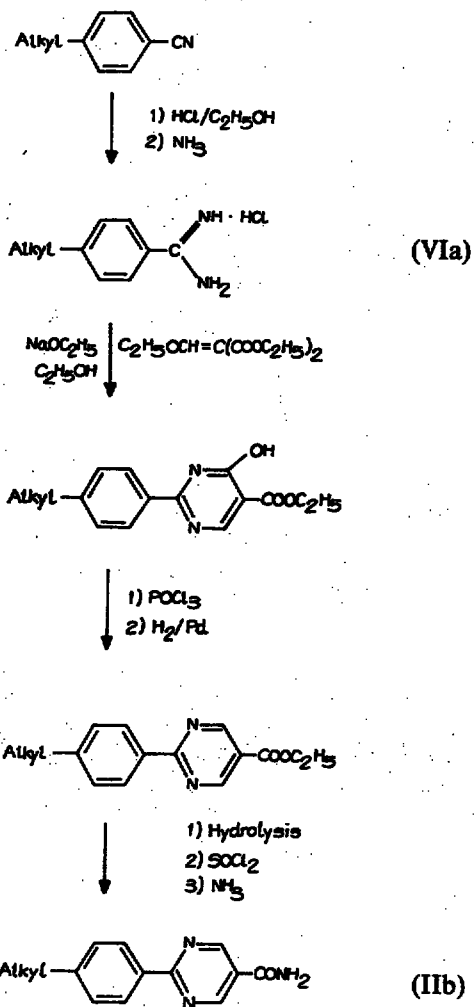
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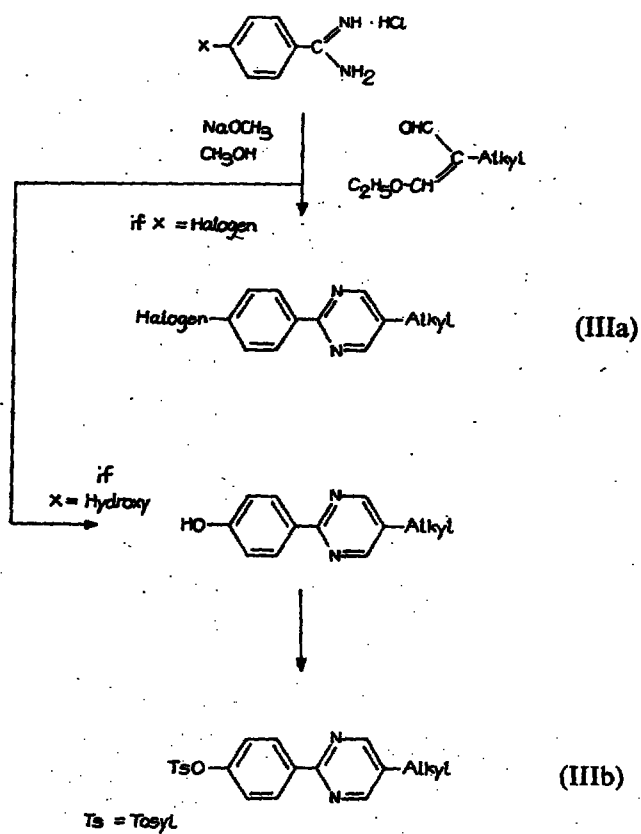
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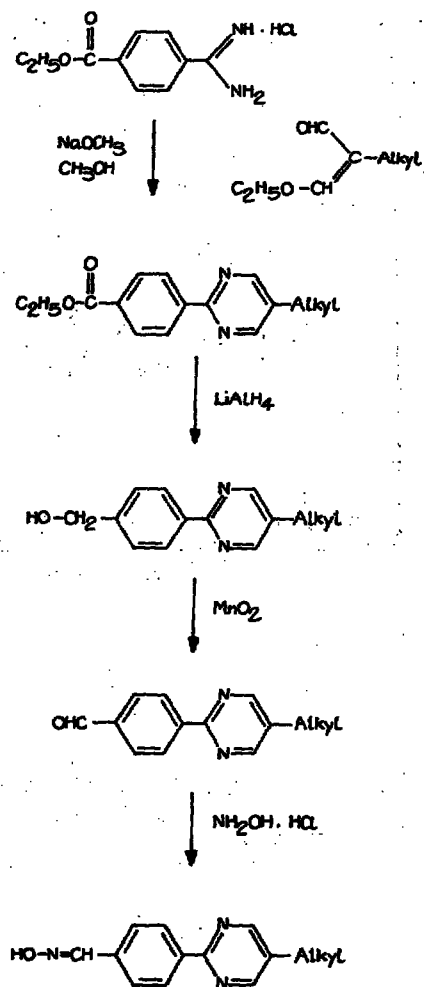
Formula Scheme B



Formula Scheme C

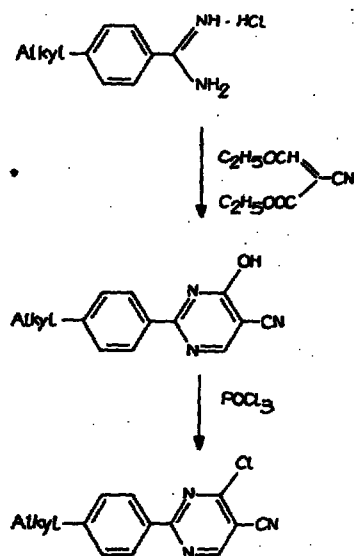


Formula Scheme D



(IV)

Formula Scheme E



(V)

The physical properties of some of the phenyl-pyrimidines of formula I are given in the following Table:

R ₁	R ₂	Melting point	Clearing point
CN	n-Pentyl	69.4°– 70.8°C	(51.9°C)*
CN	n-Hexyl	53.5°– 54.5°C	(35.5°–36.5°C)*
CN	n-Heptyl	44.2°– 44.7°C	50.1°–50.4°C
CN	n-Octyl	66.1°– 66.8°C	(47.1°C)*
n-Propyl	CN	125.9°–126.0°C	(106.4°C)*
n-Butyl	CN	108.6°–109.5°C	(101.5°C)*
n-Pentyl	CN	96.0°– 96.2°C	109.0°C
n-Hexyl	CN	86.3°– 87.8°C	102.6°–103.2(a)
n-Heptyl	CN	96.3°C	109.0°C(b)
Ethoxy	CN	152.6°–153.0°C	(149.7°C)*
n-Propoxy	CN	146.2°–146.6°C	(137.0°C)*
n-Butoxy	CN	119.1°–120.0°C	139.3°C
n-Pentyloxy	CN	98.0°– 98.1°C	133.2°C(c)
n-Hexyloxy	CN	93.5°– 93.8°C	134.0°C(d)
n-Heptyloxy	CN	102.4°C	129.5°C(e)

* monotropic clearing point

(a) smectic up to 101.3°C

(b) whole liquid crystalline range is smectic

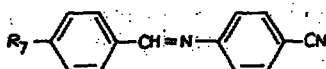
(c) smectic up to 102.1°C

(d) smectic up to 121.2°C

(e) smectic up to 126.9°C

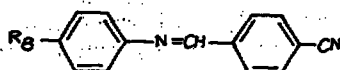
The phenyl-pyrimidines of formula I can be used in the form of mixtures with one another, mixtures which correspond to a eutectic being especially preferred.

The phenyl-pyrimidines of formula I are preferably used in the form of mixtures with other nematic or non-nematic substances such as, for example, with compounds of the general formula



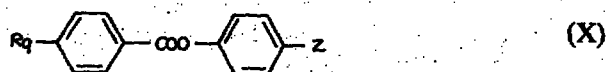
(VIII)

wherein R₇ represents a straight-chain alkyl group containing 2 to 8 carbon atoms, a straight-chain alkoxy group containing 4 to 7 carbon atoms, a straight-chain alkanoyloxy group containing 2 to 8 carbon atoms or a straight-chain alkyl-carbonate group containing 2 to 11 carbon atoms, or with compounds of the general formula

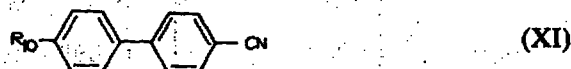


(IX)

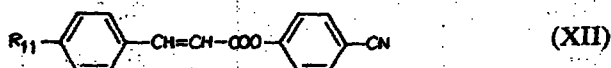
wherein R₈ represents a straight-chain alkyl group containing 4 to 7 carbon atoms or a straight-chain alkylcarbonate group containing 2 to 11 carbon atoms, or with compounds of the general formula



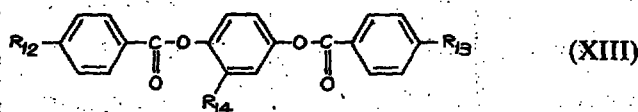
wherein Z represents the cyano group, a straight-chain alkyl group containing 1 to 9 carbon atoms, a straight-chain alkoxy group containing 1 to 9 carbon atoms or a straight-chain alkanoyloxy group containing 1 to 10 carbon atoms and R₉ represents a straight-chain alkyl group containing 4 to 8 carbon atoms, a straight-chain alkoxy group containing 5 to 8 carbon atoms, a straight-chain alkanoyloxy group containing 2 to 8 carbon atoms or a straight-chain alkylcarbonate group containing 3 to 11 carbon atoms, or with compounds of the general formula



wherein R₁₀ represents a straight-chain alkyl group (e.g. the n-pentyl, n-hexyl or n-heptyl group), a straight-chain alkoxy group (e.g. the n-pentyloxy, n-hexyloxy or n-heptyloxy group), a straight-chain alkanoyloxy group containing 4 to 9 carbon atoms or a straight-chain alkylcarbonate group containing 4 to 11 carbon atoms, or with trans-cinnamic acid esters of the general formula



wherein R₁₁ represents a straight-chain alkyl group containing 1 to 8 carbon atoms; or with compounds of the general formula



wherein R₁₂ and R₁₃ each represent a straight-chain alkyl group containing 1 to 10 carbon atoms, a straight-chain alkoxy group containing 1 to 10 carbon atoms, a straight-chain alkanoyloxy group containing 2 to 11 carbon atoms or a straight-chain alkylcarbonate group containing 2 to 11 carbon atoms and R₁₄ represents a chlorine or bromine atom or a methyl, acetyl or methoxycarbonyl group.

The compounds of formula VIII in which R₇ represents a straight-chain alkylcarbonate group containing 2 to 11 carbon atoms are novel and can be prepared by condensing a compound of the general formula



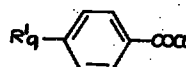
wherein R₇ represents a straight-chain alkylcarbonate group containing 2 to 11 carbon atoms, with p-aminobenzonitrile.

The compounds of formula IX in which R₈ represents a straight-chain alkylcarbonate group containing 2 to 11 carbon atoms are novel and can be prepared by condensing a compound of the general formula



wherein R₈ represents a straight-chain alkylcarbonate group containing 2 to 11 carbon atoms, with p-cyanobenzaldehyde.

The compounds of formula X in which R₉ represents a straight-chain alkylcarbonate group containing 3 to 11 carbon atoms and Z represents the cyano group are novel and can be prepared by reacting a compound of the general formula



(XVI)

wherein R', represents a straight-chain alkylcarbonate group containing 3 to 11 carbon atoms, with o-hydroxybenzonitrile.

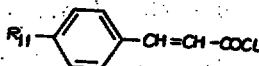
The compounds of formula XI in which R₁₀ represents a straight-chain alkanoyloxy group containing 4 to 9 carbon atoms or a straight-chain alkylcarbonate group containing 4 to 11 carbon atoms are novel and can be prepared by reacting a compound of the general formula



(XVII)

wherein R'₁₀ represents a straight-chain alkyl group containing 3 to 8 carbon atoms or a straight-chain alkoxy group containing 3 to 10 carbon atoms, with 4'-cyano-4-hydroxy-biphenyl.

The trans-cinnamic acid esters of formula XII are novel and can be prepared by reacting a compound of the general formula



(XVIII)

wherein R₁₁ has the significance given earlier, with p-hydroxybenzonitrile.

The phenyl-pyrimidines of formula I can be present in nematic mixtures for electro-optical purposes in any weight ratio or, as already mentioned, can even be used individually in nematic form for electro-optical purposes. The proportion of a phenyl-pyrimidine of formula I in a nematic mixture usually lies, however, at between 5 and 95 weight per cent and preferably at between 25 and 75 weight per cent.

The following mixtures are especially preferred:

5 - n - Pentyl - 2 - (4 - cyanophenyl) - pyrimidine and 5 - n - hexyl - 2 - (4 - cyanophenyl) - pyrimidine in a molar ratio of 1:1; melting point 38.5°—40.5°C; clearing point 43°C.

5 - n - Pentyl - 2 - (4 - cyanophenyl) - pyrimidine, p - n - hexylbenzoic acid p'-cyanophenyl ester and p-n-octylbenzoic acid p'-cyanophenyl ester in a molar ratio of 1:1:1; melting point 15°—18°C; clearing point 52.3°C.

5 - n - Hexyl - 2 - (4 - cyanophenyl) - pyrimidine, p - n - hexylbenzoic acid p'-cyanophenyl ester and p-n-octylbenzoic acid p'-cyanophenyl ester in a molar ratio of 1:1:1; melting point 14°—17°C; clearing point 52.3°C.

5 - n - Pentyl - 2 - (4 - cyanophenyl) - pyrimidine, p - n - heptylbenzoic acid p'-cyanophenyl ester and p-n-octylbenzoic acid p'-cyanophenyl ester in a molar ratio of 1:1:1; melting point 23.7°C; clearing point 55.5°C.

5 - n - Pentyl - 2 - (4 - cyanophenyl) - pyrimidine, 4' - n - heptyl - 4 - cyanobiphenyl and 4'-n-pentyl-4-cyanobiphenyl in a molar ratio of 1:1:1; melting point 20°C; clearing point 42.3°C.

5 - n - Hexyl - 2 - (4 - cyanophenyl) - pyrimidine, 4' - n - heptyl - 4 - cyanobiphenyl and 4'-n-pentyl-4-cyanobiphenyl in a molar ratio of 1:1:1; melting point 19°—21°C; clearing point 39°—40°C.

5 - n - Pentyl - 2 - (4 - cyanophenyl) - pyrimidine, and 5 - n - heptyl - 2 - (4 - cyanophenyl) - pyrimidine in a molar ratio of 1:1; melting point 25°—29°C; clearing point 49.2°C.

5 - n - Heptyl - 2 - (4 - cyanophenyl) - pyrimidine, p - n - hexanoyloxy - benzoic acid p'-ethoxyphenyl ester, p-n-hexylbenzoic acid p'-cyanophenyl ester and p-n-octylbenzoic acid p'-cyanophenyl ester in a molar ratio of 1:1:1:1; melting point 20°—22°C; clearing point 52.2°C.

5 - n - Heptyl - 2 - (4 - cyanophenyl) - pyrimidine, p - n - hexylbenzoic acid p'-cyanophenyl ester, p-n-octylbenzoic acid p'-cyanophenyl ester and methylhydroquinone di(p-n-butylbenzoate) in a molar ratio of 1:1:1:1; melting point 20°C; clearing point 67.9°C.

5 - n - Pentyl - 2 - (4 - cyanophenyl) - pyrimidine, 5 - n - heptyl - 2 - (4 - cyanophenyl) - pyrimidine and p-n-heptylbenzoic acid p'-cyanophenyl ester in a molar ratio of 1:1:1; melting point 25°—28°C; clearing point 54.3°C.

5 - n - Pentyl - 2 - (4 - cyanophenyl) - pyrimidine, 5 - n - heptyl - 2 - (4 - cyanophenyl) - pyrimidine, p-n-heptylbenzoic acid p'-cyanophenyl ester and p-n-

hexanoyloxybenzoic acid p'-ethoxyphenyl ester in a molar ratio of 1:1:1:1; melting point 14°—15°C; clearing point 55.7°C.

5 - n - Heptyl - 2 - (4 - cyanophenyl) - pyrimidine, 5 - n - pentyl - 2 - (4 - cyanophenyl) - pyrimidine and 4'-n-heptyl-4-cyanobiphenyl in a molar ratio of 1:1:1; melting point 14°C; clearing point 43.8°C.

In the following preferred mixtures percentages are on a mol % basis.

63.4% of 4'-n-pentyl-4-cyanobiphenyl, 31.6% of 4'-n-heptyl-4-cyanobiphenyl and 5.0% of 5-cyano-2-(4-n-butyloxyphenyl)-pyrimidine; melting point <0°C; clearing point 42.7°—43.0°C.

63.4% of 4'-n-pentyl-4-cyanobiphenyl, 31.6% of 4'-n-heptyl-4-cyanobiphenyl and 5.0% of 5-cyano-2-(4-n-pentylphenyl)-pyrimidine; melting point <0°C; clearing point 41.5°—41.7°C.

63.4% of 4'-n-pentyl-4-cyanobiphenyl, 31.6% of 4'-n-heptyl-4-cyanobiphenyl and 5.0% of 5-cyano-2-(4-n-pentyloxyphenyl)-pyrimidine; melting point <0°C; clearing point 42.5°—42.9°C.

60.0% of 4'-n-pentyl-4-cyanobiphenyl, 30.0% of 4'-n-heptyl-4-cyanobiphenyl and 10.0% of 5-cyano-2-(4-n-pentylphenyl)-pyrimidine; melting point <3°C; clearing point 45.2°—45.5°C.

63.4% of 4'-n-pentyl-4-cyanobiphenyl, 31.6% of 4'-n-heptyl-4-cyanobiphenyl and 5.0% of 5-cyano-2-(4-n-butylphenyl)-pyrimidine; melting point <3°C; clearing point 40.8°C.

63.4% of 4'-n-pentyl-4-cyanobiphenyl, 31.6% of 4'-n-heptyl-4-cyanobiphenyl and 5.0% of 5-cyano-2-(4-n-hexylphenyl)-pyrimidine; melting point <3°C; clearing point 40.9°—41.1°C.

57.2% of 4'-n-pentyl-4-cyanobiphenyl, 28.6% of 4'-n-heptyl-4-cyanobiphenyl, 9.5% of 5-cyano-2-(4-n-pentylphenyl)-pyrimidine and 4.7% of 5-cyano-2-(4-n-hexylphenyl)-pyrimidine; melting point <3°C; clearing point 47.7°—48.1°C.

56.8% of 4'-n-pentyl-4-cyanobiphenyl, 28.4% of 4'-n-heptyl-4-cyanobiphenyl, 9.5% of 5-cyano-2-(4-n-pentyloxyphenyl)-pyrimidine and 5.3% of 5-cyano-2-(4-n-hexylphenyl)-pyrimidine; melting point <3°C; clearing point 50.0°—50.5°C.

54.0% of 4'-n-pentyl-4-cyanobiphenyl, 27.0% of 4'-n-heptyl-4-cyanobiphenyl, 5.0% of 5-cyano-2-(4-n-butylphenyl)-pyrimidine, 9.0% of 5-cyano-2-(4-n-pentylphenyl)-pyrimidine and 5.0% of 5-cyano-2-(4-n-hexylphenyl)-pyrimidine; melting point <3°C; clearing point 50.2°—50.7°C.

54.0% of 4'-n-pentyl-4-cyanobiphenyl, 27.0% of 4'-n-heptyl-4-cyanobiphenyl, 5.0% of 5-cyano-2-(4-n-butylphenyl)-pyrimidine, 5.0% of 5-cyano-2-(4-n-hexylphenyl)-pyrimidine and 9.0% of 5-cyano-2-(4-n-pentyloxyphenyl)-pyrimidine; melting point <3°C; clearing point 52.4°—53.0°C.

49.5% of 4'-n-pentyl-4-cyanobiphenyl, 13.5% of 4'-n-heptyl-4-cyanobiphenyl, 11.7% of 4'-n-heptyloxy-4-cyanobiphenyl, 15.3% of 4'-n-octyloxy-4-cyanobiphenyl, 5.0% of 5-cyano-2-(4-n-pentylphenyl)-pyrimidine and 5.0% of 5-cyano-2-(4-n-butyloxyphenyl)-pyrimidine; melting point <3°C; clearing point 61.1°—61.4°C.

53.4% of 4'-n-pentyl-4-cyanobiphenyl, 26.6% of 4'-n-heptyl-4-cyanobiphenyl, 5.0% of 5-cyano-2-(4-n-pentylphenyl)-pyrimidine, 5.0% of 5-cyano-2-(4-n-hexylphenyl)-pyrimidine, 5.0% of 5-cyano-2-(4-n-heptylphenyl)-pyrimidine and 5.0% of 5-cyano-2-(4-n-butyloxyphenyl)-pyrimidine; melting point <3°C; clearing point 53.4°—54.0°C.

12.2% of p-[(p-n-propylbenzylidene)amino]-benzonitrile, 32.8% of p-[(p-n-butylbenzylidene)amino]-benzonitrile, 44.4% of p-[(p-n-hexylbenzylidene)amino]-benzonitrile, 1.3% of 5-cyano-2-(4-n-propylphenyl)-pyrimidine, 1.7% of 5-cyano-2-(4-n-butylphenyl)-pyrimidine, 2.2% of 5-cyano-2-(4-n-pentylphenyl)-pyrimidine, 3.4% of 5-cyano-2-(4-n-hexylphenyl)-pyrimidine and 2.0% of 5-cyano-2-(4-n-heptylphenyl)-pyrimidine; melting point <0°C; clearing point 67.6°—67.7°C.

The following Examples illustrate the process provided by the present invention and also describes the preparation of novel compounds of formulae VIII to XII:

Example 1.

1.9 g of 4-(5-n-heptylpyrimid-2-yl)-benzoic acid amide are held at reflux for 80 minutes in a mixture of 40 ml of ethylene chloride and 0.63 ml of phosphorus oxychloride while stirring. The mixture, diluted with ether, is washed with 2-N sodium hydroxide and then with water until neutral. The organic phase is dried over sodium sulphate and evaporated to give 1.9 g of 5-n-heptyl-2-(4-cyanophenyl)-pyrimidine which are distilled in a high vacuum; melting point 44.2°—44.7°C; clearing point 50.1°—50.4°C.

The starting material is prepared as follows:

0.07 mol of 2-n-heptyl-malono-tetraethylacetal are stirred in 35 ml of ethanol with 0.14 mol of water and 2 drops of concentrated sulphuric acid at 50°C under nitrogen for 15 hours. By shaking out the mixture, diluted with ether, with aqueous sodium carbonate solution, the acidic 2-heptyl-malonaldehyde produced as a by-product can be separated from the neutral 2-n-heptyl-3-ethoxy-acrolein.

A suspension of 0.1 mol of 4-amidino-benzoic acid ethyl ester hydrochloride, 0.1 mol of 2-n-heptyl-3-ethoxy-acrolein and 0.14 mol of sodium ethylate in 100 ml of methanol is stirred overnight at room temperature under nitrogen. After the usual working-up and separation into basic and acidic fractions, there is obtained 4-(5-n-heptylpyrimid-2-yl)-benzoic acid ethyl ester and 4-(5-n-heptylpyrimid-2-yl)-benzoic acid.

A. 4.4 g of 4-(5-n-heptylpyrimid-2-yl)-benzoic acid ethyl ester dissolved in 50 ml of methanol/dichloromethane (1:1) are treated with 30 ml of liquid ammonia in a laboratory autoclave and then heated to 90°C for 5 hours (pressure: 16 atmospheres). The mixture is evaporated to dryness and the poorly soluble amide separated from the unreacted starting material. There is obtained 4-(5-n-heptylpyrimid-2-yl)-benzoic acid amide.

B. 2.3 g of 4-(5-n-heptylpyrimid-2-yl)-benzoic acid and 1.9 ml of thionyl chloride are held at reflux in 100 ml of benzene for 8 hours and then the mixture is evaporated to dryness on a vacuum film evaporator. The resulting residue is dissolved in 50 ml of dichloromethane and ammonia is led into the solution at room temperature for 2 hours. There is obtained in an almost quantitative yield 4-(5-n-heptylpyrimid-2-yl)-benzoic acid amide.

In an analogous manner, the following benzoic acid amides were prepared:

4-(5-n-butylpyrimid-2-yl)-benzoic acid amide,
4-(5-n-pentylpyrimid-2-yl)-benzoic acid amide and
4-(5-n-octylpyrimid-2-yl)-benzoic acid amide.

Example 2.

11.23 g of 4-(5-n-butylpyrimid-2-yl)-benzoic acid amide are held at reflux for 90 minutes in a mixture of 250 ml of ethylene chloride and 4.5 ml of phosphorus oxychloride while stirring. The mixture, diluted with ether, is washed with 2-N sodium hydroxide and then with water until neutral. The organic phase is dried over sodium sulphate and evaporated to give 11.77 g of 5-n-butyl-2-(4-cyanophenyl)-pyrimidine which are distilled in a high vacuum; melting point 60.9°—61.8°C.

Example 3.

0.8 g of 4-(5-n-pentylpyrimid-2-yl)-benzoic acid amide are held at reflux for 80 minutes in a mixture of 20 ml of ethylene chloride and 0.35 ml of phosphorus oxychloride while stirring. The mixture, diluted with ether, is washed with 2-N sodium hydroxide and then with water until neutral. The organic phase is dried over sodium sulphate and evaporated to give 0.82 g of 5-n-pentyl-2-(4-cyanophenyl)-pyrimidine which are distilled in a high vacuum; melting point 69.4°—70.8°C; clearing point 51.9°C.

Example 4.

15.58 g of 4-(5-n-hexylpyrimid-2-yl)-benzoic acid amide are held at reflux for 90 minutes in a mixture of 350 ml of ethylene chloride and 5.58 ml of phosphorus oxychloride while stirring. The mixture, diluted with ether, is washed with 2-N sodium hydroxide and then with water until neutral. The organic phase is dried over sodium sulphate and evaporated to give 14.6 g of 5-n-hexyl-2-(4-cyanophenyl)-pyrimidine which are distilled in a high vacuum; melting point 53.5°—54.5°C; clearing point 35.5°—36.5°C.

The starting material is prepared as follows:

0.1 mol of 2-n-hexyl-malono-tetraethylacetal are stirred in 40 ml of ethanol with 0.2 mol of water and 3 drops of concentrated sulphuric acid at 50°C under nitrogen for 18 hours. By shaking out the mixture, diluted with ether, with aqueous sodium carbonate solution, the acidic 2-hexyl-malonaldehyde produced as a by-product can be separated from the neutral 2-n-hexyl-3-ethoxy-acrolein.

89 g of 4-methylimido-benzoic acid methyl ester hydrochloride, suspended in 150 ml of methanol, are treated at -40°C with 60 ml of liquid ammonia, added to a laboratory autoclave, pressurised to 30 atmospheres of nitrogen and held at 70°C

for 24 hours. The crystallised product is filtered off, washed with hexane and dried at 40°C *in vacuo* (14 mm). There are obtained 72 g of 4-amidino-benzoic acid amide hydrochloride.

0.082 mol of 4-amidino-benzoic acid amide hydrochloride, suspended in a solution of 0.082 mol of 2-n-hexyl-3-ethoxy-acrolein and 0.14 mol of sodium methylate in 150 ml of methanol, are stirred overnight under nitrogen at room temperature. The precipitate obtained by dilution of the mixture with 3 litres of ether is filtered off, washed with water until neutral and dried at 40°C in a vacuum drying cupboard. There are obtained 17.9 g of 4-(5-n-hexylpyrimid-2-yl)-benzoic acid amide; melting point 231.6°—233.0°C.

Example 5.

1.84 g of 4-(5-n-octylpyrimid-2-yl)-benzoic acid amide are held at reflux for 80 minutes in a mixture of 40 ml of ethylene chloride and 0.63 ml of phosphorus oxychloride while stirring. The mixture, diluted with ether, is washed with 2-N sodium hydroxide and then with water until neutral. The organic phase is dried over sodium sulphate and evaporated to give 1.91 g of 5-n-octyl-2-(4-cyanophenyl)-pyrimidine which are distilled in a high vacuum; melting point 66.1°—66.5°C; clearing point 47.5°C.

Example 6.

3.26 g (16.9 mmol) of the crude sodium salt of hydroxymethylene-cyanacetaldehyde diethylacetal are dissolved in 20 ml of water with stirring. 4.51 g (22.7 mmol) of p-n-propylbenzamidinium hydrochloride are added and the resulting solution, which reacts alkaline, is adjusted to pH 4—5 with 1 ml of 3-N hydrochloric acid. After stirring for 5 minutes, the mixture is concentrated to dryness at 50°C *in vacuo* and the residue is left to stand at room temperature with 50 ml of acetic anhydride for 16 hours. Then, the mixture is heated to 100°C for 1 hour, evaporated *in vacuo* and the residue (brown oil, partly crystalline) taken up in methylene chloride and chromatographed on silica gel. Elution with methylene chloride and methylene chloride/2% acetone yields the 5-cyano-2-(4-n-propylphenyl)-pyrimidine, which is recrystallised from acetone/hexane to a constant melting point and then sublimed in a high vacuum at 120°C. There are obtained colourless crystals of melting point 125.9°—126.0°C, which on cooling are liquid crystalline (monotropic) at 106.4°C.

The sodium salt of hydroxymethylene-cyanacetaldehyde diethylacetal can be prepared as follows:

A mixture of 40.9 g (0.285 mol) of cyanacetaldehyde diethylacetal, 26.2 g (0.353 mol) of formic acid ethyl ester and 100 ml of absolute ether are added dropwise while stirring to a suspension of 7.4 g (0.322 g-atoms) of powdered sodium in 500 ml of absolute ether. The mixture is stirred at room temperature until disappearance of the sodium (16 hours). Then, the brown precipitate formed (crude sodium salt of hydroxymethylene-cyanacetaldehyde diethylacetal) is left to settle and the supernatant solution is decanted off. The residue is washed by decanting twice with 200 ml of absolute ether each time. The product is stored at 0°C under absolute ether, since it changes on drying.

Example 7.

A mixture of 13.0 g (42.6 mol) of 2-(p-n-propylphenyl)-4-chloro-5-pyrimidine-carboxylic acid ethyl ester, 1.1 g of palladium-carbon (5%), 6.3 g (64.0 mmol) of anhydrous potassium acetate and 175 ml of dioxane is hydrogenated at room temperature until uptake of 1 mol of hydrogen (92 hours). The catalyst is filtered off, the filtrate evaporated *in vacuo* and any starting material present is removed by chromatography on silica gel with benzene and benzene/2% acetone as eluants. The pure, colourless 2-(p-n-propylphenyl)-5-pyrimidinecarboxylic acid ethyl ester melts at 93.5°—94.5°C after distillation in a high vacuum at 130°C (bulb tube).

9.3 g (34.4 mmol) of 2-(p-n-propylphenyl)-5-pyrimidine-carboxylic acid ethyl ester and 21.5 ml of ethanol are boiled under reflux with a solution of 16.0 g of sodium hydroxide in 107 ml of water for 1 hour. After cooling, the mixture is made congo-acidic with 82 ml of 20% hydrochloric acid and the separated 2-(p-n-propylphenyl)-5-pyrimidinecarboxylic acid is washed with water, dried and further reacted in the crude state.

8.3 g (34.4 mmol) of 2-(p-n-propylphenyl)-5-pyrimidine-carboxylic acid are boiled under reflux with 50 ml of thionyl chloride under exclusion of moisture for 2 hours, the excess thionyl chloride is removed *in vacuo* and the remaining 2-(p-n-

propylphenyl)-5-pyrimidinecarboxylic acid chloride is dissolved in 100 ml of absolute dioxane. The solution is added with stirring to a solution of 200 ml of absolute dioxane saturated with ammonia at room temperature, a colourless precipitate forming. Then, ammonia is led into the mixture for a further 4 hours, the mixture is left to stand overnight at room temperature, evaporated *in vacuo* and the residue stirred with 100 ml of water for 30 minutes. The precipitate is separated, washed with water and dried. The resulting, crude 2-(p-n-propylphenyl)-5-pyrimidinecarboxamide can be sublimed in a high vacuum at 170°C for purification; melting point from 255.1°C (decomposition).

8.3 g (34.4 mmol) of 2-(p-n-propylphenyl)-5-pyrimidine-carboxamide are boiled under reflux with 100 ml of phosphorus oxychloride under exclusion of moisture for 2 hours. Then, the excess phosphorus oxychloride is removed *in vacuo* and the mixture evaporated twice with toluene *in vacuo*. The residue is taken up in methylene chloride and chromatographed on 100 g of silica gel in methylene chloride. Elution with methylene chloride and methylene chloride/2% acetone yields the 5-cyano-2-(4-n-propylphenyl)-pyrimidine, which is recrystallised from acetone/hexane up to a constant melting point and is sublimed at 120°C in a high vacuum for purification. The pure, colourless 5-cyano-2-(4-n-propylphenyl)-pyrimidine has a melting point of 125.9°–126.0°C and on cooling is liquid crystalline (monotropic) at 106.4°C. The substance is identical with the compound obtained according to Example 6.

The starting material can be obtained according to the data of A. R. Todd and F. Bergel, J. Chem. Soc. 1937, 366 from p-n-propylbenzamidinium hydrochloride and ethoxymethylenemalononic acid diethyl ester with sodium ethylate in ethanol and subsequent treatment of the obtained 2-(p-n-propylphenyl)-4-hydroxy-5-pyrimidinecarboxylic acid ethyl ester (melting point 210.9°–211.6°C) with phosphorus oxychloride. Melting point of 2-(p-n-propylphenyl)-4-chloro-5-pyrimidinecarboxylic acid ethyl ester 67.8°–68.2°C.

Example 8.

A mixture of 11.9 g (37.3 mmol) of 2-(p-n-butylphenyl)-4-chloro-5-pyrimidinecarboxylic acid ethyl ester, 1.1 g of palladium-carbon (5%), 5.6 g (57.0 mmol) of anhydrous potassium acetate and 150 ml of dioxane is hydrogenated at room temperature until uptake of 1 mol of hydrogen (48 hours). After working-up in a manner analogous to that given in Example 7, there is obtained pure, colourless 2-(p-n-butylphenyl)-5-pyrimidinecarboxylic acid ethyl ester which, after distillation in a high vacuum at 125°C, has a melting point of 86.8°–87.1°C.

9.3 g (32.7 mmol) of 2-(p-n-butylphenyl)-5-pyrimidinecarboxylic acid ethyl ester and 20 ml of ethanol are reacted with a solution of 15.2 g of sodium hydroxide in 100 ml of water and worked-up in a manner analogous to that given in Example 7. The dry 2-(p-n-butylphenyl)-5-pyrimidinecarboxylic acid is further reacted in the crude state.

8.3 g (32.4 mmol) of 2-(p-n-butylphenyl)-5-pyrimidinecarboxylic acid are reacted with 50 ml of thionyl chloride under exclusion of moisture and worked-up in a manner analogous to that given in Example 7. The remaining 2-(p-n-butylphenyl)-5-pyrimidinecarboxylic acid chloride is dissolved in 100 ml of absolute dioxane and added to a solution of 200 ml of absolute dioxane saturated with ammonia at room temperature while stirring and further treated in a manner analogous to that given in Example 7. The obtained, crude 2-(p-n-butylphenyl)-5-pyrimidinecarboxamide can be sublimed in a high vacuum at 185°C for purification; melting point 264.0°–266.0°C.

8.2 g (32.1 mmol) of 2-(p-n-butylphenyl)-5-pyrimidinecarboxamide are reacted with 100 ml of phosphorus oxychloride under exclusion of moisture, worked-up and purified in a manner analogous to that given in Example 7. The pure, colourless 5-cyano-2-(4-n-butylphenyl)-pyrimidine has a melting point of 108.6°–109.5°C and on cooling is liquid crystalline (monotropic) at 101.5°C.

The starting material can be obtained according to the data of A. R. Todd and F. Bergel, J. Chem. Soc. 1937, 366 from p-n-butylbenzamidinium hydrochloride and ethoxymethylenemalononic acid diethyl ester with sodium ethylate in ethanol and subsequent treatment of the obtained 2-(p-n-butylphenyl)-4-hydroxy-5-pyrimidinecarboxylic acid ethyl ester (melting point 198.0°–198.8°C) with phosphorus oxychloride. Melting point of 2-(p-n-butylphenyl)-4-chloro-5-pyrimidinecarboxylic acid ethyl ester 64.9°–65.3°C.

Example 9.

A mixture of 12.6 g (37.8 mmol) of 2-(p-n-pentylphenyl)-4-chloro-5-pyrimidinecarboxylic acid ethyl ester, 1.1 g of palladium-carbon (5%), 5.6 g (57.0 mmol) of anhydrous potassium acetate and 156 ml of ethanol is hydrogenated at room temperature until uptake of 1 mol of hydrogen (1 hour). The mixture is worked-up in a manner analogous to that given in Example 7. The pure, colourless 2-(p-n-pentylphenyl)-5-pyrimidinecarboxylic acid ethyl ester has a melting point of 85.1°—86.7°C after distillation in a high vacuum at 130°C.

10.2 g (34.2 mmol) of 2-(p-n-pentylphenyl)-5-pyrimidinecarboxylic acid ethyl ester and 21 ml of ethanol are reacted with a solution of 15.8 g of sodium hydroxide in 105 ml of water and worked-up in a manner analogous to that given in Example 7. The dry 2-(p-n-pentylphenyl)-5-pyrimidinecarboxylic acid is further reacted in the crude state.

9.3 g (34.4 mmol) of 2-(p-n-pentylphenyl)-5-pyrimidinecarboxylic acid are reacted with 50 ml of thionyl chloride under exclusion of moisture and worked-up in a manner analogous to that given in Example 7. The remaining 2-(p-n-pentylphenyl)-5-pyrimidinecarboxylic acid chloride is dissolved in 100 ml of absolute dioxane and added with stirring to a solution of 200 ml of absolute dioxane saturated with ammonia at room temperature and further treated in a manner analogous to that given in Example 7. The obtained, crude 2-(p-n-pentylphenyl)-5-pyrimidinecarboxamide is directly further treated.

9.1 g (33.8 mmol) of 2-(p-n-pentylphenyl)-5-pyrimidinecarboxamide are reacted with 100 ml of phosphorus oxychloride under exclusion of moisture, worked-up and purified in a manner analogous to that given in Example 7. The pure, colourless 5-cyano-2-(4-n-pentylphenyl)-pyrimidine has a melting point of 96.0°—96.2°C and a clearing point of 109.0°C.

The starting material can be obtained according to the data of A. R. Todd and F. Bergel, *J. Chem. Soc.* 1937, 366 from p-n-pentylbenzamidinium hydrochloride and ethoxymethylenemalononic acid diethyl ester with sodium ethylate in ethanol and subsequent treatment of the obtained 2-(p-n-pentylphenyl)-4-hydroxy-5-pyrimidinecarboxylic acid ethyl ester (melting point 193.9°—194.4°C) with phosphorus oxychloride. Melting point of 2-(p-n-pentylphenyl)-4-chloro-5-pyrimidinecarboxylic acid ethyl ester 58.5°—59.2°C.

Example 10.

A mixture of 15.6 g (45.0 mmol) of 2-(p-n-hexylphenyl)-4-chloro-5-pyrimidinecarboxylic acid ethyl ester, 1.3 g of palladium-carbon (5%), 6.7 g (68.5 mmol) of anhydrous potassium acetate and 150 ml of dioxane is hydrogenated at room temperature until uptake of 1 mol of hydrogen (70 hours). The mixture is worked-up in a manner analogous to that given in Example 7. The pure, colourless 2-(p-n-hexylphenyl)-5-pyrimidinecarboxylic acid ethyl ester has a melting point of 83.2°—83.9°C after distillation in a high vacuum at 125°C.

14.1 g (45.0 mmol) of 2-(p-n-hexylphenyl)-5-pyrimidinecarboxylic acid ethyl ester and 28 ml of ethanol are reacted with a solution of 20.8 g of sodium hydroxide in 140 ml of water and worked-up in a manner analogous to that given in Example 7. The dry 2-(p-n-hexylphenyl)-5-pyrimidinecarboxylic acid is further reacted in the crude state.

12.0 g (42.2 mmol) of 2-(p-n-hexylphenyl)-5-pyrimidinecarboxylic acid are reacted with 80 ml of thionyl chloride under exclusion of moisture and worked-up in a manner analogous to that given in Example 7. The remaining 2-(p-n-hexylphenyl)-5-pyrimidinecarboxylic acid chloride is dissolved in 120 ml of absolute dioxane while warming and added with stirring to a solution of 200 ml of absolute dioxane saturated with ammonia at room temperature and further treated in a manner analogous to that given in Example 7. A sample of the obtained, crude 2-(p-n-hexylphenyl)-5-pyrimidinecarboxamide is sublimed at 180°C in a high vacuum for purification; melting point 250.2°—258.3°C.

11.5 g (40.6 mmol) of 2-(p-n-hexylphenyl)-5-pyrimidinecarboxamide are reacted with 100 ml of phosphorus oxychloride under exclusion of moisture, worked-up and purified in a manner analogous to that given in Example 7. The pure, colourless 5-cyano-2-(4-n-hexylphenyl)-pyrimidine has a melting point of 86.3°—87.8°C (smectic), is nematic at 101.3°C and has a clearing point of 102.6°—103.2°C.

The starting material can be obtained according to the data of A. R. Todd and F. Bergel, *J. Chem. Soc.* 1937, 366 from p-n-hexylbenzamidinium hydrochloride and ethoxymethylenemalononic acid diethyl ester with sodium ethylate in ethanol and

subsequent treatment of the obtained 2-(p-n-hexylphenyl)-4-hydroxy-5-pyrimidine carboxylic acid ethyl ester (melting point 189.6°—191.0°C) with phosphorus oxychloride. Melting point of 2-(p-n-hexylphenyl)-4-chloro-5-pyrimidinecarboxylic acid ethyl ester 59.4°—60.5°C.

Example 11.

A mixture of 13.4 g (37.1 mmol) of 2-(p-n-heptylphenyl)-4-chloro-5-pyrimidinecarboxylic acid ethyl ester, 1.1 g of palladium-carbon (5%), 5.5 g (56.0 mmol) of anhydrous potassium acetate and 155 ml of dioxane is hydrogenated at room temperature until uptake of 1 mol of hydrogen (68 hours). The mixture is worked-up in a manner analogous to that given in Example 7. The pure, colourless 2-(p-n-heptylphenyl)-5-pyrimidinecarboxylic acid ethyl ester has a melting point of 88.8°—89.2°C after distillation in a high vacuum at 130°C.

10.5 g (32.2 mmol) of 2-(p-n-heptylphenyl)-5-pyrimidinecarboxylic acid ethyl ester and 20 ml of ethanol are reacted with a solution of 15.2 g of sodium hydroxide in 100 ml of water and worked-up in a manner analogous to that given in Example 7. The dry 2-(p-n-heptylphenyl)-5-pyrimidinecarboxylic acid is further reacted in the crude state.

9.6 g (32.2 mmol) of crude 2-(p-n-heptylphenyl)-5-pyrimidinecarboxylic acid are reacted with 50 ml of thionyl chloride under exclusion of moisture and worked-up in a manner analogous to that given in Example 7. The remaining 2-(p-n-heptylphenyl)-5-pyrimidinecarboxylic acid chloride is dissolved in 100 ml of absolute dioxane and added with stirring to a solution of 200 ml of absolute dioxane saturated with ammonia at room temperature and further treated in a manner analogous to that given in Example 7. A sample of the obtained, crude 2-(p-n-heptylphenyl)-5-pyrimidinecarboxamide is sublimed in a high vacuum at 180°C for purification; melting point 250.8°—251.5°C.

9.1 g (30.7 mmol) of 2-(p-n-heptylphenyl)-5-pyrimidinecarboxamide are reacted with 100 ml of phosphorus oxychloride under exclusion of moisture, worked-up and purified in a manner analogous to that given in Example 7. The pure, colourless 5-cyano-2-(4-n-heptylphenyl)-pyrimidine has a melting point of 96.3°C (smectic) and a clearing point of 109.0°C.

The starting material can be obtained according to the data of A. R. Todd and F. Bergel, *J. Chem. Soc.* 1937, 366 from p-n-heptylbenzamidine hydrochloride [prepared according to H. Schubert and H. Zäschke, *J. prakt. Chem.* 312, 494 (1970)] from p-n-heptylbenzonitrile; melting point 126.0°—127.3°C] and ethoxymethylenemalononic acid diethyl ester with sodium ethylate in ethanol and subsequent treatment of the obtained 2-(p-n-heptylphenyl)-4-hydroxy-5-pyrimidinecarboxylic acid ethyl ester (melting point 184.7°—185.3°C) with phosphorus oxychloride. Melting point of 2-(p-n-heptylphenyl)-4-chloro-5-pyrimidinecarboxylic acid ethyl ester 49.2°—49.8°C.

Example 12.

A mixture of 13.0 g (38.8 mmol) of 2-(p-n-butoxyphenyl)-4-chloro-5-pyrimidinecarboxylic acid ethyl ester, 1.1 g of palladium-carbon (5%), 5.8 g (59.3 mmol) of anhydrous potassium acetate and 150 ml of dioxane is hydrogenated at room temperature until uptake of 1 mol of hydrogen (49 hours). The mixture is worked-up in a manner analogous to that given in Example 7. The pure, colourless 2-(p-n-butoxyphenyl)-5-pyrimidinecarboxylic acid ethyl ester has a melting point of 97.0°—99.3°C after distillation in a high vacuum at 130°C.

10.9 g (36.6 mmol) of 2-(p-n-butoxyphenyl)-5-pyrimidinecarboxylic acid ethyl ester and 22 ml of ethanol are reacted with a solution of 17.3 g of sodium hydroxide in 115 ml of water and worked-up in a manner analogous to that given in Example 7. The dry 2-(p-n-butoxyphenyl)-5-pyrimidinecarboxylic acid is further reacted in the crude state.

9.6 g (35.2 mmol) of 2-(p-n-butoxyphenyl)-5-pyrimidinecarboxylic acid are reacted with 60 ml of thionyl chloride under exclusion of moisture and worked-up in a manner analogous to that given in Example 7. The remaining 2-(p-n-butoxyphenyl)-5-pyrimidinecarboxylic acid chloride is dissolved in 100 ml of absolute dioxane and added with stirring to a solution of 200 ml of absolute dioxane saturated with ammonia at room temperature and further treated in a manner analogous to that given in Example 7. A sample of the obtained, crude 2-(p-n-butoxyphenyl)-5-pyrimidinecarboxamide is sublimed in a high vacuum at 180°C for purification; melting point 266.3°—270.3°C.

9.1 g (33.5 mmol) of 2-(p-n-butoxyphenyl)-5-pyrimidinecarboxamide are

reacted with 100 ml of phosphorus oxychloride under exclusion of moisture, worked-up and purified in a manner analogous to that given in Example 7. The pure, colourless 5-cyano-2-(4-n-butoxyphenyl)-pyrimidine has a melting point of 119.1°—120.0°C and a clearing point of 139.3°C.

The starting material can be obtained according to the data of A. R. Todd and F. Bergel, J. Chem. Soc. 1937, 366 from p-n-butoxybenzamidinium hydrochloride and ethoxymethylenemalononic acid diethyl ester with sodium ethylate in ethanol and subsequent treatment of the obtained 2-(p-n-butoxyphenyl)-4-hydroxy-5-pyrimidinecarboxylic acid ethyl ester (melting point 219.0°—220.0°C) with phosphorus oxychloride. Melting point of 2-(p-n-butoxyphenyl)-4-chloro-5-pyrimidinecarboxylic acid ethyl ester 81.0°—81.5°C.

Example 13.

5.0 g (19.4 mmol) of 4-chloro-5-cyano-2-(4-n-propylphenyl)-pyrimidine are boiled under reflux for 1 hour while stirring in 255 ml of 50% dioxane with 22.4 g (0.34 g-atoms) of zinc dust (treated with hydrochloric acid and washed with water). Then, the zinc is separated and washed with dioxane. The filtrate and washings are freed from dioxane *in vacuo* and the aqueous suspension is extracted with methylene chloride. The extract is dried and concentrated and the residue chromatographed on silica gel. Elution with methylene chloride and methylene chloride/2% acetone yields the 5-cyano-2-(4-n-propylphenyl)-pyrimidine, which is recrystallised from acetone/hexane up to a constant melting point and sublimed at 120°C in a high vacuum. There are obtained colourless crystals of melting point 125.9°—126.0°C, which on cooling are liquid crystalline (monotropic) at 106.4°C. The substance is identical with the compound obtained according to Example 6.

The starting material can be obtained according to the data of A. R. Todd and F. Bergel, J. Chem. Soc. 1937, 365 by reaction of p-n-propylbenzamidinium hydrochloride with α -ethoxymethylene- α -cyanoacetic acid ethyl ester and sodium ethylate in ethanol and then with sodium hydroxide solution. The resulting 5-cyano-4-hydroxy-2-(4-n-propylphenyl)-pyrimidine (melting point 246.0°—247.6°C) is treated with phosphorus oxychloride to give 4-chloro-5-cyano-2-(4-n-propylphenyl)-pyrimidine of melting point 109.4°—109.7°C.

Example 14.

5.2 g (19.1 mmol) of 4-chloro-5-cyano-2-(4-n-butylphenyl)-pyrimidine are reacted in 230 ml of 50% dioxane with 21.7 g (0.332 g-atoms) of pre-treated zinc dust and worked-up after the reaction in a manner analogous to that given in Example 13. There is obtained 5-cyano-2-(4-n-butylphenyl)-pyrimidine as colourless crystals of melting point 108.6°—109.5°C, which on cooling are nematic (monotropic) at 101.5°C. The substance is identical with the compound obtained according to Example 8.

The starting material can be obtained according to the data of A. R. Todd and F. Bergel, J. Chem. Soc. 1937, 365 by reaction of p-n-butylbenzamidinium hydrochloride with α -ethoxymethylene- α -cyanoacetic acid ethyl ester and sodium ethylate in ethanol and then with sodium hydroxide solution. The resulting 5-cyano-4-hydroxy-2-(4-n-butylphenyl)-pyrimidine (melting point 230.3°—231.3°C) is treated with phosphorus oxychloride to give 4-chloro-5-cyano-2-(4-n-butylphenyl)-pyrimidine of melting point 106.8°—107.0°C.

Example 15.

6.3 g (22.0 mmol) of 4-chloro-5-cyano-2-(4-n-pentylphenyl)-pyrimidine are reacted in 290 ml of 50% dioxane with 25.3 g (0.387 g-atoms) of pre-treated zinc dust and worked-up after the reaction in a manner analogous to that given in Example 13. There is obtained 5-cyano-2-(4-n-pentylphenyl)-pyrimidine as colourless crystals of melting point 96.0°—96.2°C and clearing point 109.0°C. The substance is identical with the compound obtained according to Example 9.

The starting material can be obtained according to the data of A. R. Todd and F. Bergel, J. Chem. Soc. 1937, 365 by reaction of p-n-pentylbenzamidinium hydrochloride with α -ethoxymethylene- α -cyanoacetic acid ethyl ester and sodium ethylate in ethanol and then with sodium hydroxide solution. The resulting 5-cyano-4-hydroxy-2-(4-n-pentylphenyl)-pyrimidine (melting point 199°—205°C) is treated with phosphorus oxychloride to give 4-chloro-5-cyano-2-(4-n-pentylphenyl)-pyrimidine of melting point 96.0°—96.3°C.

Example 16.

5.7 g (19.0 mmol) of 4-chloro-5-cyano-2-(4-n-hexylphenyl)-pyrimidine are reacted in 250 ml of 50% dioxane with 21.9 g (0.335 g-atoms) of pre-treated zinc dust and worked-up after the reaction in a manner analogous to that given in Example 13. There is obtained 5-cyano-2-(4-n-hexylphenyl)-pyrimidine as colourless crystals of melting point 86.3°—87.8°C (smectic); nematic at 101.3°C; clearing point 102.6°—103.2°C. The substance is identical with the compound obtained according to Example 10.

The starting material can be obtained according to the data of A. R. Todd and F. Bergel, J. Chem. Soc. 1937, 365 by reaction of p-n-hexylbenzamidinium hydrochloride with α -ethoxymethylene- α -cyanoacetic acid ethyl ester and sodium ethylate in ethanol and then with sodium hydroxide solution. The resulting 5-cyano-4-hydroxy-2-(4-n-hexylphenyl)-pyrimidine (melting point 204.4°—205.2°C) is treated with phosphorus oxychloride to give 4-chloro-5-cyano-2-(4-n-hexylphenyl)-pyrimidine of melting point 80.3°—80.5°C.

Example 17.

5.2 g (16.5 mmol) of 4-chloro-5-cyano-2-(4-n-heptylphenyl)-pyrimidine are reacted in 220 ml of 50% dioxane with 19.3 g (0.295 g-atoms) of pre-treated zinc dust and worked-up after the reaction in a manner analogous to that given in Example 13. There is obtained 5-cyano-2-(4-n-heptylphenyl)-pyrimidine of melting point 96.3°C (smectic) and clearing point 109.0°C. The substance is identical with the compound obtained according to Example 11.

The starting material can be obtained according to the data of A. R. Todd and F. Bergel, J. Chem. Soc. 1937, 365 by reaction of p-n-heptylbenzamidinium hydrochloride with α -ethoxymethylene- α -cyanoacetic acid ethyl ester and sodium ethylate in ethanol and then with sodium hydroxide solution. The resulting 5-cyano-4-hydroxy-2-(4-n-heptylphenyl)-pyrimidine (melting point 195.6°—198.6°C) is treated with phosphorus oxychloride to give 4-chloro-5-cyano-2-(4-n-heptylphenyl)-pyrimidine of melting point 76.3°—76.8°C.

Example 18.

5.0 g (19.2 mmol) of 4-chloro-5-cyano-2-(4-ethoxyphenyl)-pyrimidine are reacted in 250 ml of 50% dioxane with 22.2 g (0.34 g-atoms) of pre-treated zinc dust and worked-up after the reaction in a manner analogous to that given in Example 13. There is obtained 5-cyano-2-(4-ethoxyphenyl)-pyrimidine as colourless crystals of melting point 152.6°—153.0°C, which on cooling are nematic (monotropic) at 149.7°C.

The starting material can be obtained according to the data of A. R. Todd and F. Bergel, J. Chem. Soc. 1937, 365 by reaction of p-ethoxybenzamidinium hydrochloride with α -ethoxymethylene- α -cyanoacetic acid ethyl ester and sodium ethylate in ethanol and then with sodium hydroxide solution. The resulting 5-cyano-4-hydroxy-2-(4-ethoxyphenyl)-pyrimidine (melting point 288.6°—290.5°C) is treated with phosphorus oxychloride to give 4-chloro-5-cyano-2-(4-ethoxyphenyl)-pyrimidine of melting point 190.6°—192.4°C.

Example 19.

4.7 g (17.2 mmol) of 4-chloro-5-cyano-2-(4-n-propoxyphenyl)-pyrimidine are reacted in 230 ml of 50% dioxane with 20.0 g (0.306 g-atoms) of pre-treated zinc dust and worked-up after the reaction in a manner analogous to that given in Example 13. There is obtained 5-cyano-2-(4-n-propoxyphenyl)-pyrimidine as colourless crystals of melting point 146.2°—146.6°C, which on cooling are nematic (monotropic) at 137.0°C.

The starting material can be obtained according to the data of A. R. Todd and F. Bergel, J. Chem. Soc. 1937, 365 by reaction of p-n-propoxybenzamidinium hydrochloride with α -ethoxymethylene- α -cyanoacetic acid ethyl ester and sodium ethylate in ethanol and then with sodium hydroxide solution. The resulting 5-cyano-4-hydroxy-2-(4-n-propoxyphenyl)-pyrimidine (melting point 255.3°—256.5°C) is treated with phosphorus oxychloride to give 4-chloro-5-cyano-2-(4-n-propoxyphenyl)-pyrimidine of melting point 193.3°—194.4°C.

Example 20.

4.1 g (14.2 mmol) of 4-chloro-5-cyano-2-(4-n-butoxyphenyl)-pyrimidine are reacted in 190 ml of 50% dioxane with 16.4 g (0.251 g-atoms) of pre-treated zinc dust and worked-up after the reaction in a manner analogous to that given in

Example 13. There is obtained pure, colourless 5-cyano-2-(4-n-butoxyphenyl)-pyrimidine of melting point 119.1°—120.0°C and clearing point 139.3°C. The substance is identical with the compound obtained according to Example 12.

The starting material can be obtained according to the data of A. R. Todd and F. Bergel, *J. Chem. Soc.* 1937, 365 by reaction of p-n-butoxybenzamidinium hydrochloride with α -ethoxymethylene- α -cyanoacetic acid ethyl ester and sodium ethylate in ethanol and then with sodium hydroxide solution. The resulting 5-cyano-4-hydroxy-2-(4-n-butoxyphenyl)-pyrimidine (melting point 223.2°—229.5°C) is treated with phosphorus oxychloride to give 4-chloro-5-cyano-2-(4-n-butoxyphenyl)-pyrimidine of melting point 169.7°—170.2°C.

Example 21.

6.0 g (19.9 mmol) of 4-chloro-5-cyano-2-(4-n-pentyloxyphenyl)-pyrimidine are reacted in 260 ml of 50% dioxane with 23.0 g (0.325 g-atoms) of pre-treated zinc dust and worked-up after the reaction in a manner analogous to that given in Example 13. There is obtained 5-cyano-2-(4-n-pentyloxyphenyl)-pyrimidine as colourless crystals of melting point 98.0°—98.1°C (smectic); nematic at 102.1°C; clearing point 133.2°C.

The starting material can be obtained according to the data of A. R. Todd and F. Bergel, *J. Chem. Soc.* 1937, 365 by reaction of p-n-pentyloxybenzamidinium hydrochloride with α -ethoxymethylene- α -cyanoacetic acid ethyl ester and sodium ethylate in ethanol and then with sodium hydroxide solution. The resulting 5-cyano-4-hydroxy-2-(4-n-pentyloxyphenyl)-pyrimidine (melting point 213.5°—215.5°C) is treated with phosphorus oxychloride to give 4-chloro-5-cyano-2-(4-n-pentyloxyphenyl)-pyrimidine of melting point 140.5°—142.0°C.

Example 22.

3.0 g (9.5 mmol) of 4-chloro-5-cyano-2-(4-n-hexyloxyphenyl)-pyrimidine are reacted in 125 ml of 50% dioxane with 11.0 g (0.168 g-atoms) of pre-treated zinc dust and worked-up after the reaction in a manner analogous to that given in Example 13. There is obtained 5-cyano-2-(4-n-hexyloxyphenyl)-pyrimidine as colourless crystals of melting point 93.5°—93.8°C (smectic); nematic at 121.2°C; clearing point 134.0°C.

The starting material can be obtained according to the data of A. R. Todd and F. Bergel, *J. Chem. Soc.* 1937, 365 by reaction of p-n-hexyloxybenzamidinium hydrochloride with α -ethoxymethylene- α -cyanoacetic acid ethyl ester and sodium ethylate in ethanol and then with sodium hydroxide solution. The resulting 5-cyano-4-hydroxy-2-(4-n-hexyloxyphenyl)-pyrimidine [(melting point 193.0°C; smectic up to 226.0°C (clearing point)] is treated with phosphorus oxychloride to give 4-chloro-5-cyano-2-(4-n-hexyloxyphenyl)-pyrimidine of melting point 132.7°—133.1°C.

Example 23.

6.3 g (20.9 mmol) of 4-chloro-5-cyano-2-(4-n-heptyloxyphenyl)-pyrimidine are reacted in 275 ml of 50% dioxane with 23.9 g (0.366 g-atoms) of pre-treated zinc dust and worked-up after the reaction in a manner analogous to that given in Example 13. There is obtained 5-cyano-2-(4-n-heptyloxyphenyl)-pyrimidine as colourless crystals of melting point 102.4°C (smectic); nematic at 126.9°C; clearing point at 129.5°C.

The starting material can be obtained according to the data of A. R. Todd and F. Bergel, *J. Chem. Soc.* 1937, 365 by reaction of p-n-heptyloxybenzamidinium hydrochloride with α -ethoxymethylene- α -cyanoacetic acid ethyl ester and sodium ethylate in ethanol and then with sodium hydroxide solution. The resulting 5-cyano-4-hydroxy-2-(4-n-heptyloxyphenyl)-pyrimidine [(melting point 180.8°C; smectic up to 231.5°C (clearing point)] is treated with phosphorus oxychloride to give 4-chloro-5-cyano-2-(4-n-heptyloxyphenyl)-pyrimidine of melting point 133.3°—134.6°C.

Example 24.

Crude p-n-hexylcinnamic acid chloride, obtained by boiling 5.3 g (22.8 mmol) of p-n-hexylcinnamic acid with thionyl chloride, is dissolved in 35 ml of absolute benzene and added to 2.9 g (24.5 mmol) of p-hydroxybenzonitrile in 40 ml of absolute pyridine. The mixture is then heated at 50°C overnight. The mixture is poured on to ice-water and extracted three times with ether. The combined organic phases are washed with dilute hydrochloric acid. Unreacted starting

materials are separated with dilute sodium hydroxide and the ester solution is washed neutral. The crude product is recrystallised from hexane several times and there is obtained pure p-n-hexylcinnamic acid p'-cyanophenyl ester; melting point 71.5°C, clearing point 106.5°C.

The starting material can be prepared as follows:

9.4 g (49.5 mmol) of p-n-hexylbenzaldehyde in 5 ml of absolute pyridine are treated with 5.15 (49.5 mmol) of malonic acid and 5 drops of piperidine. The mixture is then heated at 100°C for 11 hours, subsequently poured on to cold aqueous hydrochloric acid and extracted with ether. The p-n-hexylcinnamic acid obtained after recrystallisation of the crude product from hexane-ether has a melting point of 107°—109°C.

Example 25.

A mixture of 6.1 g (33.9 mmol) of p-formylphenyl-carbonic acid methyl ester and 4.0 g (33.9 mmol) of p-aminobenzonitrile in 100 ml of benzene is gassed with argon and heated under reflux for 1 hour (bath temperature 135°C). The resulting water is separated with a water separator. The benzene condensing in the reflux condenser is led back into the reaction vessel for a further hour through a layer of 100 g of aluminium oxide (Activity I). After cooling, the mixture is freed from solvent *in vacuo* at 50°C (bath temperature). There are obtained 9.3 g of almost colourless crystals which are recrystallised several times from isopropanol up to a constant melting point and clearing point and until by-products disappear in the gas chromatogram. The resulting pure, colourless p-[(N-(p-cyanophenyl)-formimidoyl]-phenyl-methyl carbonate has a melting point of 139.0°—139.2°C and a clearing point of 156.0°C. UV (ethanol): $\epsilon_{274} = 2400$ (shoulders at 315 and 234 nm; minimum at 242 nm).

Example 26.

A mixture of 0.835 g (5.0 mmol) of p-methoxycarbonyloxyaniline and 0.655 g (5.0 mmol) of p-cyanobenzaldehyde in 50 ml of benzene is gassed with argon and heated under reflux for 1 hour (bath temperature 130°C). The resulting water is separated with a water separator. The benzene condensing in the reflux condenser is led back into the reaction vessel for a further hour through a layer of 20 g of aluminium oxide (Activity I). After cooling, the mixture is freed from solvent *in vacuo* at 50°C (bath temperature). There are obtained 1.395 g of yellowish crystals which are recrystallised several times from isopropanol up to a constant melting point and clearing point and until by-products disappear in the gas chromatogram. The resulting, pure, slightly yellowish p-[(p-cyanobenzylidene)aminolphenyl-methyl carbonate has a melting point of 145.1°—146.2°C and a clearing point of 163.4°C. UV (ethanol): $\epsilon_{270} = 20250$, $\epsilon_{324} = 10800$ (shoulders at 243 and 221 nm; minima at 312 and 233 nm).

Example 27.

5.66 g (47.6 mmol) of p-cyanophenol are dissolved in 66 ml of absolute pyridine and cooled to -10°C while stirring. In the course of 10 minutes, there is added portionwise thereto a total of 8.6 g (37.7 mmol) of crude p-carbethoxybenzoyl chloride. The temperature rises to 0°C and pyridine hydrochloride precipitates out. The mixture is subsequently stirred overnight at room temperature and the suspension is poured on to a mixture of 200 ml of ice and 200 ml of 20% hydrochloric acid. The mixture is extracted three times with ethyl acetate, washed with water, dried over sodium sulphate and evaporated *in vacuo*. The 12.4 g of reddish crystals obtained as the residue are dissolved in benzene and chromatographed on 400 g of silica gel. Elution with benzene/1% acetone (v/v) yields 8.1 g of yellowish crystals which are recrystallised from acetone/hexane up to a constant melting point and clearing point. The resulting, pure p-[(p-cyanophenoxy)carbonylphenyl-ethyl carbonate melts at 144.7°—144.8°C and, with cooling, is liquid crystalline (monotropic) at 115.8°C. UV (ethanol): $\epsilon_{241} = 29700$.

The starting material is prepared as follows:

Chloroformic acid ethyl ester is allowed to act on p-hydroxybenzoic acid in the presence of 1-N sodium hydroxide according to the method described by E. Fischer, Ber. 41, 2877 (1908). There is obtained crystalline p-carbethoxybenzoic acid which is treated with thionyl chloride according to the procedure described by H. Schönenberger et al., Arzneimittelforschung, 14, 324 (1964). After removal of the excess thionyl chloride *in vacuo*, there is obtained crude p-

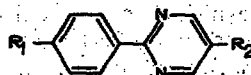
carbethoxy-oxybenzoyl chloride which is used directly in the procedure described in the first paragraph of this Example.

Example 28.

0.390 g (2.0 mmol) of 4'-cyano-4-hydroxy-biphenyl are dissolved in 4.0 ml of absolute pyridine and cooled to -10°C while stirring. In the course of 2 minutes, 0.255 g (2.4 mmol) of butyric acid chloride are added dropwise thereto. The temperature rises to 0°C and pyridine hydrochloride precipitates out. Subsequently, the mixture is stirred overnight at room temperature and the suspension is poured on to a mixture of 12 g of ice and 12 ml of 20% hydrochloric acid. The mixture is extracted three times with ethyl acetate, washed with water, dried over sodium sulphate and evaporated *in vacuo*. The 0.552 g of yellowish crystals obtained as the residue are dissolved in benzene and chromatographed on 40 g of silica gel. Elution with benzene yields 0.521 g of yellowish crystals which are recrystallised from acetone/hexane up to a constant melting point and clearing point. The resulting, pure 4'-cyano-4-biphenyl butyrate melts at $77.9^{\circ}\text{--}78.2^{\circ}\text{C}$ and on cooling is liquid crystalline (monotropic) at 74.7°C . UV (ethanol: $\epsilon_{212} = 26100$).

WHAT WE CLAIM IS:—

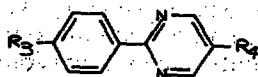
1. Phenyl-pyrimidines of the general formula



(I)

wherein one of the symbols R_1 and R_2 represents the cyano group and the other represents a straight-chain alkyl group containing 3 to 9 carbon atoms, a straight-chain alkoxy group containing 2 to 9 carbon atoms or a straight-chain alkanoyloxy group containing 2 to 9 carbon atoms.

2. 5-n-Pentyl-2-(4-cyanophenyl)-pyrimidine.
3. 5-n-Hexyl-2-(4-cyanophenyl)-pyrimidine.
4. 5-n-Heptyl-2-(4-cyanophenyl)-pyrimidine.
5. 5-n-Octyl-2-(4-cyanophenyl)-pyrimidine.
6. 5-Cyano-2-(4-n-propylphenyl)-pyrimidine.
7. 5-Cyano-2-(4-n-butylphenyl)-pyrimidine.
8. 5-Cyano-2-(4-n-pentylphenyl)-pyrimidine.
9. 5-Cyano-2-(4-n-hexylphenyl)-pyrimidine.
10. 5-Cyano-2-(4-n-heptylphenyl)-pyrimidine.
11. 5-Cyano-2-(4-ethoxyphenyl)-pyrimidine.
12. 5-Cyano-2-(4-n-propoxyphenyl)-pyrimidine.
13. 5-Cyano-2-(4-n-butoxyphenyl)-pyrimidine.
14. 5-Cyano-2-(4-n-pentyloxyphenyl)-pyrimidine.
15. 5-Cyano-2-(4-n-hexyloxyphenyl)-pyrimidine.
16. 5-Cyano-2-(4-n-heptyloxyphenyl)-pyrimidine.
17. A process for the manufacture of the phenyl-pyrimidines of formula I given in claim 1, which process comprises
 - (a) dehydrating a compound of the general formula



(II)

wherein one of the symbols R_3 and R_4 represents a straight-chain alkyl group containing 3 to 9 carbon atoms, a straight-chain alkoxy group containing 2 to 9 carbon atoms or a straight-chain alkanoyloxy group containing 2 to 9 carbon atoms and the other represents the aminocarbonyl group,

or
(b) for the manufacture of phenyl-pyrimidines of formula I wherein R_1 represents the cyano group and R_2 represents a straight-chain alkyl group containing 3 to 9 carbon atoms, a straight-chain alkoxy group containing 2 to 9 carbon atoms or a straight-chain alkanoyloxy group containing 2 to 9 carbon atoms, reacting a compound of the general formula



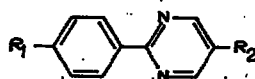
carbethoxy-oxybenzoyl chloride which is used directly in the procedure described in the first paragraph of this Example.

Example 28.

0.390 g (2.0 mmol) of 4'-cyano-4-hydroxy-biphenyl are dissolved in 4.0 ml of absolute pyridine and cooled to -10°C while stirring. In the course of 2 minutes, 0.255 g (2.4 mmol) of butyric acid chloride are added dropwise thereto. The temperature rises to 0°C and pyridine hydrochloride precipitates out. Subsequently, the mixture is stirred overnight at room temperature and the suspension is poured on to a mixture of 12 g of ice and 12 ml of 20% hydrochloric acid. The mixture is extracted three times with ethyl acetate, washed with water, dried over sodium sulphate and evaporated *in vacuo*. The 0.552 g of yellowish crystals obtained as the residue are dissolved in benzene and chromatographed on 40 g of silica gel. Elution with benzene yields 0.521 g of yellowish crystals which are recrystallised from acetone/hexane up to a constant melting point and clearing point. The resulting, pure 4'-cyano-4-biphenyl butyrate melts at $77.9^{\circ}\text{--}78.2^{\circ}\text{C}$ and on cooling is liquid crystalline (monotropic) at 74.7°C . UV (ethanol: $\epsilon_{272} = 26100$).

WHAT WE CLAIM IS:—

1. Phenyl-pyrimidines of the general formula

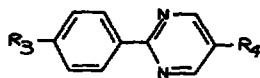


(I)

wherein one of the symbols R_1 and R_2 represents the cyano group and the other represents a straight-chain alkyl group containing 3 to 9 carbon atoms, a straight-chain alkoxy group containing 2 to 9 carbon atoms or a straight-chain alkanoyloxy group containing 2 to 9 carbon atoms.

2. 5-n-Pentyl-2-(4-cyanophenyl)-pyrimidine.
3. 5-n-Hexyl-2-(4-cyanophenyl)-pyrimidine.
4. 5-n-Heptyl-2-(4-cyanophenyl)-pyrimidine.
5. 5-n-Octyl-2-(4-cyanophenyl)-pyrimidine.
6. 5-Cyano-2-(4-n-propylphenyl)-pyrimidine.
7. 5-Cyano-2-(4-n-butylphenyl)-pyrimidine.
8. 5-Cyano-2-(4-n-pentylphenyl)-pyrimidine.
9. 5-Cyano-2-(4-n-hexylphenyl)-pyrimidine.
10. 5-Cyano-2-(4-n-heptylphenyl)-pyrimidine.
11. 5-Cyano-2-(4-ethoxyphenyl)-pyrimidine.
12. 5-Cyano-2-(4-n-propoxyphenyl)-pyrimidine.
13. 5-Cyano-2-(4-n-butoxyphenyl)-pyrimidine.
14. 5-Cyano-2-(4-n-pentyloxyphenyl)-pyrimidine.
15. 5-Cyano-2-(4-n-hexyloxyphenyl)-pyrimidine.
16. 5-Cyano-2-(4-n-heptyloxyphenyl)-pyrimidine.
17. A process for the manufacture of the phenyl-pyrimidines of formula I given in claim 1, which process comprises

(a) dehydrating a compound of the general formula



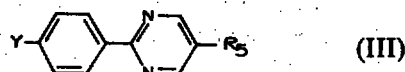
(II)

wherein one of the symbols R_3 and R_4 represents a straight-chain alkyl group containing 3 to 9 carbon atoms, a straight-chain alkoxy group containing 2 to 9 carbon atoms or a straight-chain alkanoyloxy group containing 2 to 9 carbon atoms and the other represents the aminocarbonyl group, or

(b) for the manufacture of phenyl-pyrimidines of formula I wherein R_1 represents the cyano group and R_2 represents a straight-chain alkyl group containing 3 to 9 carbon atoms, a straight-chain alkoxy group containing 2 to 9 carbon atoms or a straight-chain alkanoyloxy group containing 2 to 9 carbon atoms, reacting a compound of the general formula

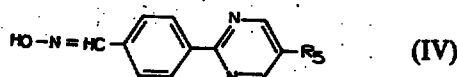


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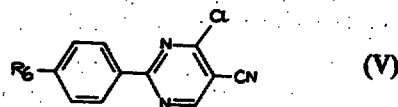
wherein R_1 represents a straight-chain alkyl group containing 3 to 9 carbon atoms, a straight-chain alkoxy group containing 2 to 9 carbon atoms or a straight-chain alkanoyloxy group containing 2 to 9 carbon atoms and Y represents a halogen atom or an arylsulphonyloxy group, with copper (I) cyanide or sodium cyanide,

or
(c) for the manufacture of phenyl-pyrimidines of formula I wherein R_1 represents the cyano group and R_2 represents a straight-chain alkyl group containing 3 to 9 carbon atoms, a straight-chain alkoxy group containing 2 to 9 carbon atoms or a straight-chain alkanoyloxy group containing 2 to 9 carbon atoms, dehydrating a compound of the general formula



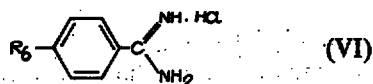
wherein R_1 has the significance given earlier in this claim,

(d) for the manufacture of phenyl-pyrimidines of formula I wherein R_1 represents a straight-chain alkyl group containing 3 to 9 carbon atoms, a straight-chain alkoxy group containing 2 to 9 carbon atoms or a straight-chain alkanoyloxy group containing 2 to 9 carbon atoms and R_2 represents the cyano group, reductively dehalogenating a compound of the general formula



wherein R_1 represents a straight-chain alkyl group containing 3 to 9 carbon atoms, a straight-chain alkoxy group containing 2 to 9 carbon atoms or a straight-chain alkanoyloxy group containing 2 to 9 carbon atoms,

or
(e) for the manufacture of phenyl-pyrimidines of formula I wherein R_1 represents a straight-chain alkyl group containing 3 to 9 carbon atoms, a straight-chain alkoxy group containing 2 to 9 carbon atoms or a straight-chain alkanoyloxy group containing 2 to 9 carbon atoms and R_2 represents the cyano group, reacting a compound of the general formula



wherein R_1 has the significance given earlier in this claim, with an alkali salt of acetalised hydroxymethylene-cyanacetaldehyde.

18. A process for the manufacture of the phenyl-pyrimidines of formula I given in claim 1, substantially as hereinbefore described with reference to any one of the foregoing Examples 1 to 23.

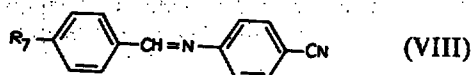
19. Phenyl-pyrimidines of formula I given in claim 1, when manufactured by the process claimed in claim 17 or 18.

20. A nematic mixture for electro-optical purposes which consists of one or more phenyl-pyrimidines of formula I given in claim 1 and, if desired, other nematic substances and/or non-nematic substances.

21. A nematic mixture according to claim 20 which contains phenyl-pyrimidines as claimed in claims 2 to 16 inclusive.

22. A nematic mixture according to claim 20, which contains exclusively phenyl-pyrimidines of formula I given in claim 1.

23. A nematic mixture according to claim 20 which contains phenyl-pyrimidines of formula I given in claim 1 and compounds of the general formula





* C L M S *

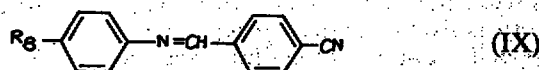
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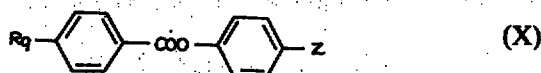
wherein R_7 represents a straight-chain alkyl group containing 2 to 8 carbon atoms, a straight-chain alkoxy group containing 4 to 7 carbon atoms, a straight-chain alkanoyloxy group containing 2 to 8 carbon atoms or a straight-chain alkylcarbonate group containing 2 to 11 carbon atoms.

24. A nematic mixture according to claim 20 which contains phenylpyrimidines of formula I given in claim 1 and compounds of the general formula



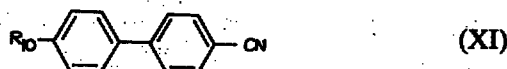
wherein R_8 represents a straight-chain alkyl group containing 4 to 7 carbon atoms or a straight-chain alkylcarbonate group containing 2 to 11 carbon atoms.

25. A nematic mixture according to claim 20 which contains phenylpyrimidines of formula I given in claim 1 and compounds of the general formula



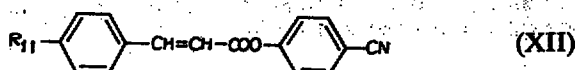
wherein Z represents the cyano group, a straight-chain alkyl group containing 1 to 9 carbon atoms, a straight-chain alkoxy group containing 1 to 9 carbon atoms or a straight-chain alkanoyloxy group containing 1 to 10 carbon atoms and R_9 represents a straight-chain alkyl group containing 4 to 8 carbon atoms, a straight-chain alkoxy group containing 5 to 8 carbon atoms, a straight-chain alkanoyloxy group containing 2 to 8 carbon atoms or a straight-chain alkylcarbonate group containing 3 to 11 carbon atoms.

26. A nematic mixture according to claim 20 which contains phenylpyrimidines of formula I given in claim 1 and compounds of the general formula



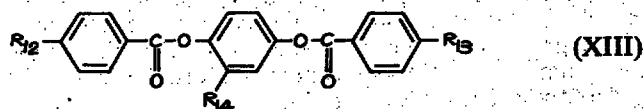
wherein R_{10} represents a straight-chain alkyl group (e.g. n-pentyl, n-hexyl or n-heptyl), a straight-chain alkoxy group (n-pentyloxy, n-hexyloxy or n-heptyloxy), a straight-chain alkanoyloxy group containing 4 to 9 carbon atoms or a straight-chain alkylcarbonate group containing 4 to 11 carbon atoms.

27. A nematic mixture according to claim 20 which contains phenylpyrimidines of formula I given in claim 1 and compounds of the general formula



wherein R_{11} represents a straight-chain alkyl group containing 1 to 8 carbon atoms.

28. A nematic mixture according to claim 20 which contains phenylpyrimidines of formula I given in claim 1 and compounds of the general formula



wherein R_{12} and R_{13} each represent a straight-chain alkyl group containing 1 to 10 carbon atoms, a straight-chain alkoxy group containing 1 to 10 carbon atoms, a straight-chain alkanoyloxy group containing 2 to 11 carbon atoms or a straight-chain alkylcarbonate group containing 2 to 11 carbon atoms and R_{14} represents a chlorine or bromine atom or a methyl, acetyl or methoxycarbonyl group.

29. A nematic mixture according to claim 20 which consists of 5-n-pentyl-2-(4-cyanophenyl)-pyrimidine, p-n-hexylbenzoic acid p'-cyanophenyl ester and p-n-octylbenzoic acid p'-cyanophenyl ester.

30. A nematic mixture according to claim 20 which consists of 5-n-hexyl-2-(4-cyanophenyl)-pyrimidine, p-n-hexylbenzoic acid p'-cyanophenyl ester and p-n-octylbenzoic acid p'-cyanophenyl ester.

31. A nematic mixture according to claim 20 which consists of 5-n-hexyl-2-(4-cyanophenyl)-pyrimidine, 4'-n-heptyl-4-cyanobiphenyl and 4'-n-pentyl-4-cyanobiphenyl.



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32. A nematic mixture according to claim 20 which consists of 5-n-pentyl-2-(4-cyanophenyl)-pyrimidine and 5-n-heptyl-2-(4-cyanophenyl)-pyrimidine.

33. A nematic mixture according to claim 20 which consists of 5-n-heptyl-2-(4-cyanophenyl)-pyrimidine, p-n-hexanoyloxybenzoic acid p'-ethoxyphenyl ester, p-n-hexylbenzoic acid p'-cyanophenyl ester and p-n-octylbenzoic acid p'-cyanophenyl ester.

34. A nematic mixture according to claim 20 which consists of 5-n-heptyl-2-(4-cyanophenyl)-pyrimidine, p-n-hexylbenzoic acid p'-cyanophenyl ester, p-n-octylbenzoic acid p'-cyanophenyl ester and methylhydroquinone di-(p-n-butylbenzoate).

35. A nematic mixture according to claim 20 which consists of 5-n-heptyl-2-(4-cyanophenyl)-pyrimidine, 5-n-pentyl-2-(4-cyanophenyl)-pyrimidine and 4'-n-heptyl-4-cyanobiphenyl.

36. A nematic mixture according to claim 20 which consists of 4'-n-pentyl-4-cyanobiphenyl, 4'-n-heptyl-4-cyanobiphenyl and 5-cyano-2-(4-n-butoxyphenyl)-pyrimidine.

37. A nematic mixture according to claim 20 which consists of 4'-n-pentyl-4-cyanobiphenyl, 4'-n-heptyl-4-cyanobiphenyl and 5-cyano-2-(4-n-pentylphenyl)-pyrimidine.

38. A nematic mixture according to claim 20 which consists of 4'-n-pentyl-4-cyanobiphenyl, 4'-n-heptyl-4-cyanobiphenyl and 5-cyano-2-(4-n-hexylphenyl)-pyrimidine.

39. A nematic mixture according to claim 20 which consists of 4'-n-pentyl-4-cyanobiphenyl, 4'-n-heptyl-4-cyanobiphenyl, 5-cyano-2-(4-n-pentyloxyphenyl)-pyrimidine and 5-cyano-2-(4-n-hexylphenyl)-pyrimidine.

40. A nematic mixture according to claim 20 which consists of 4'-n-pentyl-4-cyanobiphenyl, 4'-n-heptyl-4-cyanobiphenyl, 5-cyano-2-(4-n-butylphenyl)-pyrimidine, 5-cyano-2-(4-n-pentylphenyl)-pyrimidine and 5-cyano-2-(4-n-hexylphenyl)-pyrimidine.

41. A nematic mixture according to claim 20 which consists of 4'-n-pentyl-4-cyanobiphenyl, 4'-n-heptyl-4-cyanobiphenyl, 5-cyano-2-(4-n-butylphenyl)-pyrimidine, 5-cyano-2-(4-n-hexylphenyl)-pyrimidine and 5-cyano-2-(4-n-pentyloxyphenyl)-pyrimidine.

42. A nematic mixture according to claim 20 which consists of 4'-n-pentyl-4-cyanobiphenyl, 4'-n-heptyl-4-cyanobiphenyl, 4'-n-heptyloxy-4-cyanobiphenyl, 4'-n-octyloxy-4-cyanobiphenyl, 5-cyano-2-(4-n-pentylphenyl)-pyrimidine and 5-cyano-2-(4-n-butoxyphenyl)-pyrimidine.

43. A nematic mixture according to claim 20 which consists of p-[(p-n-propylbenzylidene)aminol-benzonitrile, p-[(p-n-butylbenzylidene)aminol-benzonitrile, p-[(p-n-hexylbenzylidene)aminol-benzonitrile, 5-cyano-2-(4-n-propylphenyl)-pyrimidine, 5-cyano-2-(4-n-butylphenyl)-pyrimidine, 5-cyano-2-(4-n-pentylphenyl)-pyrimidine, 5-cyano-2-(4-n-hexylphenyl)-pyrimidine and 5-cyano-2-(4-n-heptylphenyl)-pyrimidine.

44. A process for the manufacture of nematic mixtures, which process comprises mixing phenyl-pyrimidines of formula I given in claim 1 with one another and/or with other nematic substances and/or non-nematic substances.

45. A process according to claim 44, wherein phenyl-pyrimidines as claimed in claims 2 to 16 inclusive are used.

46. A process according to claim 44, wherein phenyl-pyrimidines of formula I given in claim 1 are mixed with one another.

47. A process according to claim 44, wherein one or more phenyl-pyrimidines of formula I given in claim 1 are mixed with one or more compounds of formula VIII given in claim 23.

48. A process according to claim 44, wherein one or more phenyl-pyrimidines of formula I given in claim 1 are mixed with one or more compounds of formula IX given in claim 24.

49. A process according to claim 44, wherein one or more phenyl-pyrimidines of formula I given in claim 1 are mixed with one or more compounds of formula X given in claim 25.

50. A process according to claim 44, wherein one or more phenyl-pyrimidines of formula I given in claim 1 are mixed with one or more compounds of formula XI given in claim 26.

51. A process according to claim 44, wherein one or more phenyl-pyrimidines of formula I given in claim 1 are mixed with one or more compounds of formula XII given in claim 27.



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52. A process according to claim 44, wherein one or more phenyl-pyrimidines of formula I given in claim 1 are mixed with one or more compounds of formula XIII given in claim 28.

53. A process according to claim 44, wherein the components of the nematic mixtures of any of claims 29 to 43 are mixed together.

54. An electro-optical apparatus containing a phenyl-pyrimidine of formula I given in claim 1 in liquid crystalline condition.

55. An electro-optical apparatus containing a phenyl-pyrimidine as claimed in any one of claims 2 to 16 inclusive in liquid crystalline condition.

56. An electro-optical apparatus containing a liquid crystalline nematic mixture as claimed in any one of claims 20 to 43 inclusive.

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Printed for Her Majesty's Stationery Office by the Courier Press, Leamington Spa, 1977.
Published by the Patent Office, 25 Southampton Buildings, London, WC2A 1AY, from
which copies may be obtained.