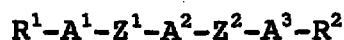


The invention relates to nitrogen-containing heterocyclic compounds of the formula I



wherein

5 R^1 and R^2 in each case independently of one another are an alkyl group having 1-15 C atoms, it also being possible for one or two non-adjacent CH_2 groups to be replaced by O atoms and/or -CO- groups and/or -O-CO- groups and/or -CO-O- groups, and one of the radicals R^1 and R^2 is also H, F, Cl, Br or CN,

10 A^1 is a 1,4-cyclohexylene group, it also being possible for one or two non-adjacent CH_2 groups to be replaced by O atoms, a 1,4-bicyclo-(2,2,2)-octylene group or a 1,3-dithiane-2,5-diyl group,

15 Z^1 and Z^2 in each case independently of one another are - CH_2CH_2 -, - OCH_2 -, - CH_2O - or a single bond, and

20 A^2 and A^3 in each case independently of one another are a 1,4-phenylene group, pyrimidine-2,5-diyl group, 1,4-cyclohexylene group, it also being possible for one or two non-adjacent CH_2 groups to be replaced by O atoms, 1,3-dithiane-2,5-diyl group or a 1,4-bicyclo(2,2,2)-octylene group,

25 with the provisos that

- (a) at least one of the groups A^2 and A^3 is a pyrimidine-2,5-diyl group,
- (b) at least one of the groups Z^1 and Z^2 is not a single bond if A^2 is pyrimidine-2,5-diyl and R^2 is alkyl or CN,
- (c) 2-(4-cyanophenyl)-5-[2-(trans-4-ethylcyclohexyl)-ethyl]-pyrimidine,
- 35 2-(4-cyanophenyl)-5-[2-(trans-4-propylcyclohexyl)-ethyl]-pyrimidine,
- 2-(4-cyanophenyl)-5-[2-(trans-4-butylcyclohexyl)-ethyl]-pyrimidine,

2-(4-cyanophenyl)-5-[2-(trans-4-pentylcyclohexyl)-ethyl]-pyrimidine, and

2-(4-cyanophenyl)-5-[2-(trans-4-heptylcyclohexyl)-ethyl]-pyrimidine,

5 is (sic) excluded, and for the contracting states CH, DE, GB and Li.

(d) 5-alkyl-2-(4'-(trans-4"-alkylcyclohexyl)-phenyl)pyrimidines are excluded.

10 For simplicity, in the following text Cy is a 1,4-cyclohexylene group, Dio is a 1,3-dioxane-2,5-diyl group, Dit is a 1,3-dithiane-2,5-diyl group, Bi is a 1,4-bicyclo(2,2,2)-octylene group, Phe is a 1,4-phenylene group and Pyr is a pyrimidine-2,5-diyl group.

15 Similar compounds are known, for example, from German Patent Specification 2,257,588. However, in contrast to the present compounds, the compounds mentioned therein contain no saturated rings (Cy, Dio, Dit or Bi).

20 5-Alkyl-2-(4-benzoyloxy- and -cyclohexylcarbonyloxyphenyl)-pyrimidines are furthermore known from EP-A-0,025,119. In contrast to the compounds according to the invention, these have an ester group (-COO-) between two cyclic groups.

25 4-(5-Phenyl- or -cyclohexyl)-pyrimidine-2-yl)-benzene derivatives are known from EP-A-0,014,885 and DE-OS-3,140,868. In contrast, in accordance with proviso b), the compounds according to the invention contain at least one group Z^1 or Z^2 which differs from a single bond if R^2 is CN or alkyl.

30 Liquid crystal mixtures which contain compounds, the general formula of which also includes the compounds according to the invention, are claimed in EP-A-0,056,501 and GB-A-2,092,169; however, only 2-(p-alkylphenyl)-5-cyano- and -5-alkyl-pyrimidines are described there.

35 With reference to the earlier Application EP-A-0,104,011 which has not been previously published, the Applicant has imposed a limitation in accordance with proviso d) in the contracting states Switzerland, The Federal Republic of Germany, Great Britain and Lichten-

stein designated therein, and has submitted separate patent claims for the contracting state France.

5 With reference to the earlier Application EP-A-0,149,208 which has not previously been published, the Applicant has imposed a limitation in accordance with proviso c) in all the designated contracting states.

10 Like similar compounds, the compounds of the formula I can be used as components of liquid crystal phases, in particular for displays which are based on the principle of the twisted cell (TN displays), the guest/host effect, the effect of deformation of aligned phases or the effect of dynamic scattering.

15 The invention was based on the object of discovering new stable liquid crystal or mesogenic compounds which are suitable as components of liquid crystal phases.

20 It has been found that the compounds of the formula I are outstandingly suitable as components of liquid crystal phases. In particular, stable liquid crystal phases for TN displays with high multiplexing rates can be prepared with the aid of these compounds.

25 Surprisingly, when compounds of the formula I were added to liquid crystal phases, it was found that even the addition of relatively large amounts (for example 10-30%) only insignificantly increased the threshold voltage. At the same time, a considerable improvement in the steepness of the characteristic line of the mixture completely unexpectedly occurred, so that compounds of type I are to be regarded as particularly
30 advantageously suitable substances for the preparation of liquid crystal mixtures with a steep characteristic line.

35 They therefore make possible the development of mixtures of high multiplexing capacity and of very small optical anisotropy, with which a twisting cell, in particular, can be operated in the first transmission minimum according to Gooch-Tarry. A very small dependency of the contrast on the observation angle thereby results.

Furthermore, by providing the compounds of the formula I, the range of liquid crystal substances which

are suitable, from various technological viewpoints, for the preparation of nematic mixtures is also quite generally considerably extended.

5 The compounds of the formula I have a wide range of applications. Depending on the choice of the substituents, these compounds can be used as base materials, from which liquid crystal dielectrics are predominantly composed; however, compounds of the formula I can also be added to liquid crystal base materials from other classes
10 of compounds, for example in order to reduce the dielectric and/or optical anisotropy of such a dielectric. The compounds of the formula I are furthermore suitable as intermediates for the preparation of other substances which can be used as constituents of liquid crystal
15 dielectrics.

The compounds of the formula I are colourless in the pure state and form liquid crystal mesophases in a temperature range which is advantageously located for electrooptical use. They are very stable towards chemicals, heat and light.
20

The invention thus relates to the compounds of the formula I and to a process for their preparation, characterized in that a compound which otherwise corresponds to the formula I but contains one or more
25 reducible groups and/or C-C bonds instead of H atoms is treated with a reducing agent, or in that, to prepare esters of the formula I (wherein R^1 and/or R^2 are an alkyl group, in which one or two CH_2 groups are replaced by $-O-CO-$ groups and/or $-CO-O-$ groups), a corresponding carboxylic acid or one of its
30 reactive derivatives is reacted with a corresponding alcohol or one of its reactive derivatives, or in that, to prepare 1,3-dioxane derivatives or 1,3-dithiane derivatives of the formula I (wherein A^1 is
35 1,3-dioxane-2,5-diyl or 1,3-dithiane-2,5-diyl), a corresponding aldehyde is reacted with a corresponding diol or dithiol, or in that, to prepare ethers of the formula I (wherein R^1 and/or R^2 are an alkyl group, in which one or two CH_2

groups are replaced by O atoms, and/or Z is an -OCH₂- or -CH₂-O- group), a corresponding hydroxy compound is etherified),

5 and/or in that, if appropriate, a base of the formula I is converted into one of its acid addition salts by treatment with an acid.

10 The invention furthermore relates to the use of the compounds of the formula I as components of liquid crystal phases. The invention moreover relates to liquid crystal phases containing at least one compound of the formula I and to liquid crystal display elements, in particular electrooptical display elements, containing such phases.

15 The invention furthermore relates to liquid crystal phases containing at least two liquid crystal components, characterized in that at least one component is a compound of the formula I

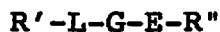


20 wherein R¹, R², A¹, A², A³, Z¹ and Z² have the meaning given in Claim 1,

with the provisos that

- (a) at least one of the groups A² and A³ is a pyrimidine-2,5-diyl group, and
- 25 (b) at least one of the groups Z¹ and Z² is not a single bond if A² is pyrimidine-2,5-diyl and R² is alkyl or CN, and
- (c) 2-(4-cyanophenyl)-5-[2-(trans-4-ethylcyclohexyl)-ethyl]-pyrimidine,
- 30 2-(4-cyanophenyl)-5-[2-(trans-4-propylcyclohexyl)-ethyl]-pyrimidine,
- 2-(4-cyanophenyl)-5-[2-(trans-4-butylcyclohexyl)-ethyl]-pyrimidine,
- 35 2-(4-cyanophenyl)-5-[2-(trans-4-pentylcyclohexyl)-ethyl]-pyrimidine, and
- 2-(4-cyanophenyl)-5-[2-(trans-4-heptylcyclohexyl)-ethyl]-pyrimidine,
- is (sic) excluded,

and it contains (sic) at least one constituent of the formula II.



II

wherein

5 L and E are each a carbo- or heterocyclic ring system from the group formed by 1,4-disubstituted benzene and cyclohexane rings, 4,4'-disubstituted biphenyl, phenylcyclohexane and cyclohexylcyclohexane systems, 2,5-disubstituted pyrimidine and
10 1,3-dioxane rings, 2,6-disubstituted naphthalene, di- and tetrahydronaphthalene, quinazoline and tetrahydroquinazoline,

G is

15	-CH=CH-	-N(O)=N-
	-CH=CY-	-CH=N(O)-
	-CH=C-(sic)	-CH ₂ CH ₂ -
	-CO-O-	-CH ₂ -O-
	-CO-S-	-CH ₂ -S-
	-CH=N-	-COO-Ph-COO-

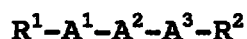
20 Y is halogen or -CN and

R' and R'' are alkoxy, alkanoyloxy or alkoxy-carbonyloxy having up to 8 carbon atoms, or one of these radicals is also CN, NC, NO₂, CF₃, F, Cl or Br, or it contains (sic) at least one other constituent
25 selected from the classes of benzylideneanilines, terphenyls, cyclohexylbiphenyls, cyclohexylcyclohexanes, cyclohexylnaphthalenes, 1,4-bis-cyclohexylbenzenes, 4,4'-bis-cyclohexylbiphenyls, optionally halogenated stilbenes, benzyl phenyl
30 ethers, tolanes and substituted cinnamic acids.

Above and below, R¹, R², A¹, A², A³, Z¹ and Z² have the meaning given, unless expressly indicated otherwise.

The compounds of the formula I accordingly include Ic, If, Ii and Il (with three rings):

35



Ic

$R^1-A^1-Z^1-A^2-A^3-R^2$ If

$R^1-A^1-A^2-Z^2-A^3-R^2$ Ii

$R^1-A^1-Z^1-A^2-Z^2-A^3-R^2$ Il

5 The preferred compounds of the part formula Ic include those of the part formulae Ica to Iccc:

	$R^1-Cy-Pyr-Phe-R^2$	Ica
	$R^1-Cy-Phe-Pyr-R^2$	Icc
	$R^1-Cy-Pyr-Cy-R^2$	Ice
	$R^1-Cy-Cy-Pyr-R^2$	Icf
10	$R^1-Cy-Pyr-Dio-R^2$	Icg
	$R^1-Dio-Pyr-Cy-R^2$	Ich
	$R^1-Cy-Dio-Pyr-R^2$	Ici
	$R^1-Dio-Cy-Pyr-R^2$	Icj
	$R^1-Cy-Pyr-Dit-R^2$	Ick
15	$R^1-Dit-Pyr-Cy-R^2$	Icl
	$R^1-Cy-Dit-Pyr-R^2$	Icm
	$R^1-Dit-Cy-Pyr-R^2$	Icn
	$R^1-Cy-Pyr-Bi-R^2$	Ico
	$R^1-Bi-Pyr-Cy-R^2$	Icp
20	$R^1-Cy-Bi-Pyr-R^2$	Icq
	$R^1-Bi-Cy-Pyr-R^2$	Icr
	$R^1-Dio-Pyr-Phe-R^2$	Ics
	$R^1-Dio-Phe-Pyr-R^2$	Icu
	$R^1-Dit-Pyr-Phe-R^2$	Icw
25	$R^1-Dit-Phe-Pyr-R^2$	Icy
	$R^1-Bi-Pyr-Phe-R^2$	Icaa
	$R^1-Bi-Phe-Pyr-R^2$	Iccc

Of these, those of the part formula Icf and compounds of the part formula Icc, wherein R² is CN, are particularly preferred.

5 The preferred compounds of the part formula If include those of the part formula Ifc to Ift:

	R ¹ -A ¹ -CH ₂ CH ₂ -A ² -A ³ -R ²	Ifc
	R ¹ -A ¹ -OCH ₂ -A ² -A ³ -R ²	Ifd
	R ¹ -A ¹ -CH ₂ O-A ² -A ³ -R ²	Ife
	R ¹ -Cy-Z ¹ -A ² -A ³ -R ²	Iff
10	R ¹ -Dio-Z ¹ -A ² -A ³ -R ²	Ifg
	R ¹ -Dit-Z ¹ -A ² -A ³ -R ²	Ifh
	R ¹ -Bi-Z ¹ -A ² -A ³ -R ²	Ifi
	R ¹ -Cy-Z ¹ -Pyr-Phe-R ²	Ifj
	R ¹ -Cy-Z ¹ -Phe-Pyr-R ²	Ifk
15	R ¹ -Cy-Z ¹ -Pyr-Cy-R ²	Ifl
	R ¹ -Cy-Z ¹ -Cy-Pyr-R ²	Ifm
	R ¹ -Cy-Z ¹ -Pyr-Dio-R ²	Ifn
	R ¹ -Dio-Z ¹ -Pyr-Phe-R ²	Ifo
	R ¹ -Dio-Z ¹ -Phe-Pyr-R ²	Ifp
20	R ¹ -Dit-Z ¹ -Pyr-Phe-R ²	Ifq
	R ¹ -Dit-Z ¹ -Phe-Pyr-R ²	Ifr
	R ¹ -Bi-Z ¹ -Pyr-Phe-R ²	Ifs
	R ¹ -Bi-Z ¹ -Phe-Pyr-R ²	Ift

25 Of these, those of the part formulae Ifc and Ife as well as Ij, Ik and Il are particularly preferred.

The preferred compounds of the part formula Ii include those of the part formulae Iic to Iiu:

	R ¹ -A ¹ -A ² -CH ₂ CH ₂ -A ³ -R ²	Iic
	R ¹ -A ¹ -A ² -CH ₂ O-A ³ -R ²	Iid
30	R ¹ -A ¹ -A ² -OCH ₂ -A ³ -R ²	Iie
	R ¹ -Cy-A ² -Z ² -A ³ -R ²	Iif
	R ¹ -Dio-A ² -Z ² -A ³ -R ²	Iig
	R ¹ -Dit-A ² -Z ² -A ³ -R ²	Iih
	R ¹ -Bi-A ² -Z ² -A ³ -R ²	Iii
35	R ¹ -Cy-Pyr-Z ² -Phe-R ²	Iij
	R ¹ -Cy-Pyr-Z ² -Cy-R ²	Iik

	$R^1\text{-Cy-Phe-Z}^2\text{-Pyr-R}^2$	Iil
	$R^1\text{-Cy-Cy-Z}^2\text{-Pyr-R}^2$	Iim
	$R^1\text{-Dio-Cy-Z}^2\text{-Pyr-R}^2$	Iin
	$R^1\text{-Dit-Cy-Z}^2\text{-Pyr-R}^2$	Iio
5	$R^1\text{-Dio-Pyr-Z}^2\text{-Phe-R}^2$	Iip
	$R^1\text{-Dit-Pyr-Z}^2\text{-Phe-R}^2$	Iiq
	$R^1\text{-Dio-Pyr-Z}^2\text{-Cy-R}^2$	Iir
	$R^1\text{-Dit-Pyr-Z}^2\text{-Cy-R}^2$	Iis
	$R^1\text{-Bi-Pyr-Z}^2\text{-Cy-R}^2$	Iit
10	$R^1\text{-Bi-Pyr-Z}^2\text{-Phe-R}^2$	Iin (sic)

Of these, those of the part formula Iic are particularly preferred.

The preferred compounds of the part formula II include those of the part formulae Ili:



In the compounds of the formulae above and below, R^1 and R^2 are preferably alkyl, and furthermore alkoxy, oxaalkyl or CN.

20 A^1 is preferably Cy or Dio, and furthermore preferably Dit or Bi. The compound of the formula I preferably contains not more than one of the radicals Dio, Dit or Bi.

A^2 and A^3 are preferably Phe or Pyr, and furthermore preferably Cy, Dio or Dit.

25 Z^1 and Z^2 are preferably single bonds, and secondly preferably $\text{-CH}_2\text{CH}_2\text{-}$ groups. Compounds of the formula I wherein one of the groups Z^1 and Z^2 is a single bond and the other is $\text{-CH}_2\text{CH}_2\text{-}$, $\text{-OCH}_2\text{-}$ or $\text{-CH}_2\text{O-}$ are particularly preferred.

30 The alkyl radicals in the groups R^1 and/or R^2 can be straight-chain or branched. Preferably, they are straight-chain and have 2, 3, 4, 5, 6, 7, 8, 9, 10, 11 or 12 C atoms, and accordingly are preferably ethyl, propyl, butyl, pentyl, hexyl, heptyl, octyl, nonyl, decyl, 35 undecyl or dodecyl, and furthermore methyl, tridecyl, tetradecyl or pentadecyl.

If R^1 and/or R^2 are alkyl radicals in which one ("alkoxy" or "oxaalkyl") or two ("alkoxyalkoxy" or "dioxalkyl") CH_2 groups are replaced by O atoms, they

can be straight-chain or branched. Preferably, they are straight-chain and have 2, 3, 4, 5, 6 or 7 C atoms, and are accordingly preferably ethoxy, propoxy, butoxy, pentoxy, hexoxy, heptoxy, 2-oxapropyl (= methoxymethyl), 2- (= ethoxymethyl) or 3-oxabutyl (= 2-methoxyethyl), 2-, 3- or 4-oxapentyl, 2-, 3-, 4- or 5-oxaheptyl or 2-, 3-, 4-, 5- or 6-oxaheptyl, and furthermore methoxy, octoxy, nonoxy, decoxy, 2-, 3-, 4-, 5-, 6- or 7-oxaoctyl, 2-, 3-, 4-, 5-, 6-, 7- or 8-oxanonyl, 2-, 3-, 4-, 5-, 6-, 7-, 8- or 9-oxadecyl, 1,3-dioxabutyl (= methoxymethoxy), 1,3-, 1,4- or 2,4-dioxapentyl, 1,3-, 1,4-, 1,5-, 2,4-, 2,5- or 3,5-dioxaheptyl or 1,3-, 1,4-, 1,5-, 1,6-, 2,4-, 2,5-, 2,6-, 3,5-, 3,6- or 4,6-dioxaheptyl.

Compounds of the formulae I and of the part formulae above and below with branched end group substituents R^1 and/or R^2 may occasionally be of importance because of a better solubility in the usual liquid crystal base materials, but in particular as chiral doping substances, if they are optically active. Branched groups of this type as a rule contain not more than one chain branching. Preferred branched radicals R^1 are isopropyl, 2-butyl (= 1-methylpropyl), isobutyl (= 2-methylpropyl), 2-methylbutyl, isopentyl (= 3-methylbutyl), 2-methylpentyl, 3-methylpentyl, 2-ethylhexyl, 2-propylpentyl, 2-octyl, isopropoxy, 2-methylpropoxy, 2-methylbutoxy, 3-methylbutoxy, 2-methylpentoxy, 3-methylpentoxy, 2-ethylhexoxy, 1-methylhexoxy, 1-methylheptoxy, 2-oxa-3-methylbutyl, 3-oxa-4-methylpentyl and 2-octyloxy.

Of the compounds of the formulae I and of the part formulae above and below, those in which at least one of the radicals contained therein has one of the preferred meanings mentioned are preferred. Particularly preferred smaller groups of compounds are those of the formulae I1 to I7 and I13 to I20

35	Alkyl-Cy-Cy-Pyr-Alkyl	I1
	Alkyl-Cy-Cy-Pyr-Alkoxy	I2
	Alkyl-Dio-Cy-Pyr-Alkyl	I3
	Alkyl-Cy-CH ₂ CH ₂ -Phe-Pyr-Alkyl	I4

	Alkyl-Cy-CH ₂ CH ₂ -Phe-Pyr-Alkoxy	I5
	Alkyl-Cy-CH ₂ CH ₂ -Phe-Pyr-CN	I6
	Alkyl-Cy-Pyr-Phe-Alkoxy	I7
	Alkyl-Cy-CH ₂ CH ₂ -Pyr-Phe-Alkyl	I13
5	Alkyl-Cy-CH ₂ CH ₂ -Pyr-Phe-Alkoxy	I14
	Alkyl-Cy-CH ₂ CH ₂ -Pyr-Phe-CN	I15
	Alkyl-Cy-Pyr-CH ₂ CH ₂ -Phe-Alkyl	I16
	Alkyl-Cy-Pyr-CH ₂ CH ₂ -Phe-Alkoxy	I17
	Alkyl-Cy-Pyr-CH ₂ CH ₂ -Phe-CN	I18
10	Alkyl-Cy-Pyr-CH ₂ CH ₂ -Cy-alkyl	I19
	Alkyl-Cy-CH ₂ -O-Phe-Pyr-alkyl	I20

Of these, those of the formulae I1, I2, I4, I5, I6, I13, I14, I15 and I20 are particularly preferred.

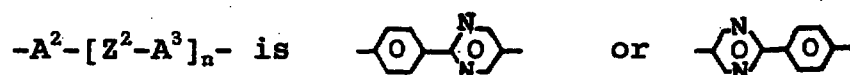
In the above formulae I 1 to I 20, alkyl is preferably a straight-chain alkyl group having 2 to 10 C atoms and alkoxy is a straight-chain alkoxy group having 2 to 12 C atoms. Compounds of the formulae I 1 to I 20 in which a 2-oxaalkyl group having 2 to 12 C atoms is present instead of alkoxy are furthermore preferred.

Of the compounds of the formula I, those stereoisomers in which the saturated rings (for example Cy, Dio and Dit) are trans-1,4-disubstituted are preferred.

Those of the abovementioned formulae which contain one or more of the groups Dio, Dit and/or Pyr in each case include the two possible 2,5-position isomers. Those of the abovementioned formulae in which a group Z¹ and/or Z² which is other than a single bond is linked with Pyr in the 5-position are preferred.

Particularly preferred compounds of the formula I and of the above part formulae are those wherein R¹ is a straight-chain alkyl group having 1 to 10 C atoms and R² is a straight-chain alkoxy, oxaalkyl or alkyl group having 2 to 15 C atoms, in particular having 5 to 12 C atoms.

Compounds of the formula I wherein Z¹ is -CH₂CH₂-, -OCH₂- or -CH₂O-, if A¹ is 1,4-cyclohexylene and



are furthermore preferred.

5 The compounds of the formula I are prepared by methods which are known per se, such as are described in the literature (for example in the standard works, such as Houben-Weyl, Methoden der Organischen Chemie (Methods of Organic Chemistry), Georg-Thieme-Verlag, Stuttgart), and in particular under reaction conditions which are known and suitable for the reactions mentioned. It is also possible to utilize variants which are known per se and are not mentioned here in more detail.

10 The expert can find corresponding synthesis methods from the prior art by routine methods (for example German Offenlegungsschriften 2,344,732, 2,450,088, 2,429,093, 2,502,904, 2,636,684, 2,701,591 and 15 2,752,975 in respect of compounds with 1,4-cyclohexylene and 1,4-phenylene groups; German Patent Specification 2,641,724 in respect of compounds with pyrimidine-2,5-diyl groups; German Offenlegungsschriften 2,944,905 and 3,227,916 in respect of compounds with 1,3-dioxane-2,5-diyl groups; 20 East German Patent Specification 160,061 in respect of compounds with 1,3-dithiane-2,5-diyl groups; U.S. Patent Specification 4,261,652 and 4,219,256 in respect of compounds with 1,4-bicyclo(2,2,2)-octylene groups; and German Offenlegungsschrift 3,201,721 in 25 respect of compounds with $-\text{CH}_2\text{CH}_2-$ bridge members.

If desired, the starting substances can also be formed in situ such that they are not isolated from the reaction mixture but are immediately reacted further to give the compounds of the formula I.

30 Thus, the compounds of the formula I can be prepared by reducing a compound which otherwise corresponds to the formula I but contains one or more reducible groups and/or C-C bonds instead of H atoms.

35 Preferred possible reducible groups are carbonyl groups, in particular keto groups, and furthermore, for example, free or esterified hydroxyl groups or aromatically bonded halogen atoms. Preferred starting substances for the reduction correspond to the formula I, but can

contain a cyclohexene ring or cyclohexanone ring instead of a cyclohexane ring, and/or a $-\text{CH}=\text{CH}-$ group instead of a $-\text{CH}_2\text{CH}_2-$ group, and/or a $-\text{CO}-$ group instead of a $-\text{CH}_2-$ group, and/or a free or functionally modified (for example in the form of its p-toluenesulfonate) OH group instead of an H atom.

The reduction can be carried out, for example, by catalytic hydrogenation at temperatures between about 0°C and about 200°C and under pressures between about 1 and 200 bar in an inert solvent, for example an alcohol, such as methanol, ethanol or isopropanol, an ether, such as tetrahydrofuran (THF) or dioxane, an ester, such as ethyl acetate, a carboxylic acid, such as acetic acid, or a hydrocarbon, such as cyclohexane. Advantageously suitable catalysts are noble metals, such as Pt or Pd, which can be used in the form of oxides (for example PtO_2 or PdO), on a support (for example Pd on charcoal, calcium carbonate or strontium (sic) carbonate) or in finely divided form.

Ketones can also be reduced by the methods of Clemmensen (with zinc, zinc amalgam or tin and hydrochloric acid, advantageously in aqueous-alcoholic solution or in a heterogeneous phase system with water/-toluene, at temperatures between about 80 and 120°) or Wolff-Kishner (with hydrazine, advantageously in the presence of alkali, such as KOH or NaOH, in a high-boiling solvent, such as diethylene glycol or triethylene glycol, at temperatures between about 100 and 200°C) to give the corresponding compounds of the formula I containing alkyl groups and/or $-\text{CH}_2\text{CH}_2-$ bridges.

Reductions with complex hydrides are furthermore possible. For example arylsulfonyloxy groups can be removed by reduction with LiAlH_4 , and in particular p-toluenesulfonyloxymethyl groups can be reduced to methyl groups, advantageously in an inert solvent, such as diethyl ether or THF, at temperatures between about 0 and 100°C . Double bonds can be hydrogenated with NaBH_4 or tributyl-tin hydride in methanol (even in the presence of CN groups!); thus, for example, the corresponding cyclohexane deriva-

tives are formed from 1-cyanocyclohexene derivatives.

Esters of the formula I (R^1 and/or R^2 = alkyl, wherein one or two CH_2 groups are replaced by $-O-CO-$ and/or $-CO-O-$ groups, or Z^1 and/or Z^2 = $-CO-O-$ or $-O-CO-$) can also be obtained by esterification of corresponding carboxylic acids (or their reactive derivatives) with alcohols or phenols (or their reactive derivatives).

Particularly suitable reactive derivatives of the carboxylic acids mentioned are the acid halides, in particular the chlorides and bromides, and furthermore the anhydrides, azides or esters, in particular alkyl esters with 1-4 C atoms in the alkyl group.

Particularly suitable reactive derivatives of the alcohols or phenols mentioned are the corresponding metal alcoholates or phenolates, preferably of an alkali metal, such as Na or K.

The esterification is advantageously carried out in the presence of an inert solvent. Particularly suitable solvents are ethers, such as diethyl ether, di-n-butyl ether, THF, dioxane or anisole, ketones, such as acetone, butanone or cyclohexanone, amides, such as DMF or phosphoric acid hexamethyltriamide, hydrocarbons, such as benzene, toluene or xylene, halogenohydrocarbons, such as carbon tetrachloride or tetrachloroethylene, and sulfoxides, such as dimethylsulfoxide or sulfolane. Water-immiscible solvents can at the same time advantageously be used for azeotropic removal by distillation of the water formed during the esterification. An excess of an organic base, for example pyridine, quinoline or triethylamine, can occasionally also be used as the solvent for the esterification. The esterification can also be carried out in the absence of a solvent, for example by simply heating the components in the presence of sodium acetate. The reaction temperature is usually between -50° and $+250^\circ$, preferably between -20° and $+80^\circ$. At these temperatures, the esterification reactions are as a rule ended after 15 minutes to 48 hours.

In detail, the reaction conditions for the esterification largely depend on the nature of the starting sub-

stances used. Thus, a free carboxylic acid is as a rule reacted with a free alcohol or phenol in the presence of a strong acid, for example a mineral acid, such as hydrochloric acid or sulfuric acid. A preferred reaction procedure is to react an acid anhydride or, in particular, an acid chloride with an alcohol, preferably in a basic medium, bases which are of importance being, in particular, alkali metal hydroxides, such as sodium hydroxide or potassium hydroxide, alkali metal carbonates or bicarbonates, such as sodium carbonate, sodium bicarbonate, potassium carbonate or potassium bicarbonate, alkali metal acetates, such as sodium acetate or potassium acetate, alkaline earth metal hydroxides, such as calcium hydroxide, or organic bases, such as triethylamine, pyridine, lutidine, collidine or quinoline. Another preferred embodiment of the esterification comprises first converting the alcohol or phenol into the sodium or potassium alcoholate or phenolate, for example by treatment with ethanolic sodium hydroxide solution or potassium hydroxide solution, isolating this product and suspending it in acetone or diethyl ether, together with sodium bicarbonate or potassium carbonate, with stirring, and adding a solution of the acid chloride or anhydride in diethyl ether, acetone or DMF to this suspension, advantageously at temperatures between about -25° and $+20^{\circ}$.

Dioxane derivatives and dithiane derivatives of the formula I (wherein one of the groups A^1 and/or A^2 and/or A^3 is a 1,3-dioxane-2,5-diyl group or a 1,3-dithiane-2,5-diyl group) are advantageously prepared by reacting a corresponding aldehyde with a corresponding 1,3-diol or a corresponding 1,3-dithiol (or one of its reactive derivatives), preferably in the presence of an inert solvent, such as benzene or toluene, and/or a catalyst, for example a strong acid, such as sulfuric acid or benzene- or p-toluene-sulfonic acid, at temperatures between about 20° and about 150° , preferably between 80° and 120° . Suitable reactive derivatives of the starting substances are, above all, acetals.

The aldehydes, 1,3-diols and 1,3-dithiols men-

tioned and their reactive derivatives are known in some cases, and some of them can be prepared without difficulty by standard processes of organic chemistry from compounds which are known from the literature. For example, the aldehydes can be obtained by oxidation of corresponding carboxylic acids or their derivatives, the diols can be obtained by reduction of corresponding diesters, and the dithiols can be obtained by reaction of corresponding dihalides with NaSH.

To prepare nitriles of the formula I (wherein R^1 and/or R^2 are CN), corresponding acid amides can be dehydrated. The amides can be obtained, for example, from corresponding esters or acid halides by reaction with ammonia. Examples of suitable dehydrating agents are inorganic acid chlorides, such as $SOCl_2$, PCl_3 , PCl_5 , $POCl_3$, SO_2Cl_2 or $COCl_2$, and furthermore P_2O_5 , P_2S_5 , $AlCl_3$ (for example as a double compound with NaCl) and aromatic sulfonic acids and sulfonic acid halides. The dehydration can be carried out in the presence or absence of an inert solvent at temperatures between about 0° and 150° ; examples of possible solvents are bases, such as pyridine or triethylamine, aromatic hydrocarbons, such as benzene, toluene or xylene, or amides, such as DMF.

To prepare the abovementioned nitriles of the formula I, it is also possible to react corresponding acid halides, preferably the chlorides, with sulfamide, advantageously in an inert solvent, such as tetramethylene sulfone, at temperatures between about 80° and 150° , preferably at 120° . After customary working up, the nitriles can be isolated directly.

Ethers of the formula I (wherein R^1 and/or R^2 are an alkyl group, wherein one or two CH_2 groups can be replaced by O atoms, and/or wherein Z^1 and/or Z^2 is a $-OCH_2-$ or a $-CH_2O-$ group) can be obtained by etherification of corresponding hydroxy compounds, preferably corresponding phenols, the hydroxy compound advantageously first being converted into a corresponding metal derivative, for example into the corresponding alkali metal alcoholate or alkali metal phenolate by treatment with

NaH, NaNH_2 , NaOH, KOH, Na_2CO_3 or K_2CO_3 . This derivative can then be reacted with the corresponding alkyl halide or sulfonate or dialkyl sulfate, advantageously in an inert solvent, such as acetone, 1,2-dimethoxyethane, dimethylformamide or dimethylsulfoxide, or even an excess of aqueous or aqueous-alcoholic NaOH or KOH, at temperatures between about 20° and 100° .

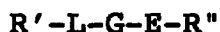
A base of the formula I can be converted into the associated acid addition salt with an acid. For this reaction, it is possible to use inorganic acids, for example sulfuric acid, nitric acid, hydrogen halide acids, such as hydrochloric acid or hydrobromic acid, phosphoric acids, such as orthophosphoric acid, or sulfamic acid, and furthermore organic acids, in particular aliphatic, alicyclic, araliphatic, aromatic or heterocyclic monobasic or polybasic carboxylic, sulfonic or sulfuric acids, for example formic acid, acetic acid, propionic acid, pivalic acid, diethylacetic acid, malonic acid, succinic acid, pimelic acid, fumaric acid, maleic acid, lactic acid, tartaric acid, malic acid, benzoic acid, salicylic acid, 2- or 3-phenylpropionic acid, citric acid, gluconic acid, ascorbic acid, nicotinic acid, isonicotinic acid, methane- or ethane-sulfonic acid, ethanedisulfonic acid, 2-hydroxyethanesulfonic acid, benzenesulfonic acid, p-toluenesulfonic acid, naphthalene-mono- and -di-sulfonic acids or lauryl-sulfuric acid.

Conversely, it is possible to liberate the base of the formula I from an acid addition salt of a compound of the formula I by treatment with a base, for example with a strong inorganic base, such as KOH or NaOH.

The liquid crystal phases according to the invention consist of 2 to 15, preferably 3 to 12, components, at least one of which is a compound of the formula I. The other constituents are preferably chosen from the nematic or nematogenic substances, in particular the known substances, from the classes of the azoxybenzenes, benzylideneanilines, biphenyls, terphenyls, phenyl or cyclohexyl benzoates, phenyl or cyclohexyl cyclohexane-

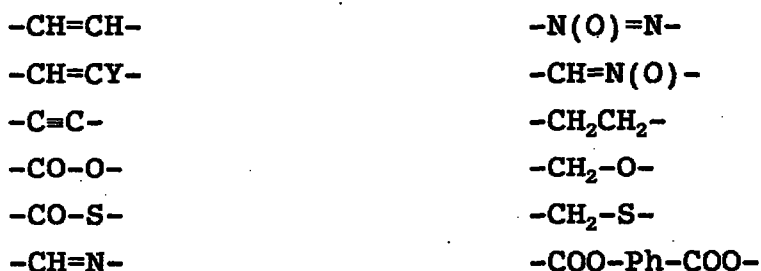
carboxylates, phenylcyclohexanes, cyclohexylbiphenyls, cyclohexylcyclohexanes, cyclohexylnaphthalenes, 1,4-bis-cyclohexylbenzenes, 4,4'-bis-cyclohexylbiphenyls, phenyl- or cyclohexyl-pyrimidines, phenyl- or cyclohexyl-diox-
5 anes, phenyl- or cyclohexyl-1,3-dithianes, 1,2-bis-cyclohexylethanes, 1,2-bis-phenylethanes, 1-phenyl-2-cyclohexylethanes, optionally halogenated stilbenes, benzyl phenyl ethers, tolans and substituted cinnamic acids.

10 The most important compounds which are suitable as constituents of such liquid crystal phases can be characterized by the formula II



II

wherein L and E are each a carbocyclic or heterocyclic ring system from the group formed by 1,4-disubstituted
15 benzene and cyclohexane rings, 4,4'-disubstituted biphenyl, phenylcyclohexane and cyclohexylcyclohexane systems, 2,5-disubstituted pyrimidine and 1,3-dioxane rings, 2,6-disubstituted naphthalene, di- and tetrahydro-naphthalene, quinazoline and tetrahydroquinazoline,
20 G is



or a C-C single bond, Y is halogen, preferably chlorine, or -CN, and R' and R'' are alkyl, alkoxy, alkanoyloxy or
30 alkoxy-carbonyloxy with up to 18, preferably up to 8, carbon atoms, or one of these radicals is also CN, NC, NO₂, CF₃, F, Cl or Br.

In most of these compounds, R' and R'' are different from one another, one of these radicals usually being an alkyl or alkoxy group. However, other variants
35 of the envisaged substituents can also be used. Many such substances or mixtures thereof are commercially available. All of these substances can be prepared by methods

which are known from the literature.

The phases according to the invention contain about 0.1 to 99%, preferably 10 to 95%, of one or more compounds of the formula I.

5 Dielectrics according to the invention containing 0.1 to 40%, preferably 0.5 to 30%, of one or more compounds of the formula I are furthermore preferred.

The dielectrics according to the invention are prepared in a manner which is customary per se. As a
10 rule, the components are dissolved in one another, advantageously at elevated temperature.

The liquid crystal dielectrics according to the invention can be modified by suitable additives so that they can be used in all the types of liquid
15 crystal display elements which have hitherto been disclosed.

Such additives are known to the expert and are described in detail in the literature. For example, it is possible to add conductive salts, preferably ethyl-
20 dimethyl-dodecyl-ammonium 4-hexyloxybenzoate, tetrabutyl-ammonium tetraphenylboranate or complex salts of crown ethers (compare, for example I. Haller et al., Mol. Cryst.Liq.Cryst. volume 24, pages 249-258 (1973)) to improve the conductivity, dichroic dyestuffs to prepare
25 coloured guest/host systems, or substances for modifying the dielectric anisotropy, the viscosity and/or the orientation of the nematic phases. Such substances are described, for example, in German Offenlegungsschriften 2,209,127, 2,240,864, 2,321,632, 2,338,281, 2,450,088,
30 2,637,430, 2,853,728 and 2,902,177.

The following examples are intended to illustrate the invention without limiting it. m.p. = melting point, c.p. = clear point. Percentages above and below are by weight; all the temperature data are given in degrees
35 Celsius. "Customary working up" means: water is added, the mixture is extracted with methylene chloride, the organic phase is separated off, dried and evaporated and the product is purified by crystallization and/or chromatography.

Example 1.

65 g of trans,trans-4'-butyl-bicyclohexyl-4-carbonitrile, which is known, are dissolved in a mixture of 50 ml of ethanol and 50 ml of toluene. 27 g of HCl are passed into the solution, which is kept at 10°, in the course of 2 hours, the mixture is then stirred at room temperature for 16 hours and the resulting precipitate is filtered off with suction and washed with diethyl ether. Yield: 78 g of trans,trans-4'-butyl-bicyclohexyl-4'-carboximic acid ethyl ester hydrochloride.

77 g of the imide ester are suspended in 140 ml of ethanol and the suspension is added to a solution of 22 g of ammonia in 160 ml of ethanol at room temperature, in the course of 15 minutes. After 16 hours, the solvent is distilled off under reduced pressure. The residue is filtered off with suction and washed with diethyl ether. Yield: 67 g of trans,trans-4'-butyl-bicyclohexyl-4-carboximide-amide hydrochloride.

60 g of the carboximide-amide are heated at 150° together with 40 g of pentylmalonodialdehyde bis-diethyl acetal for 15 hours. After cooling, the residue is dissolved in ethanol. Customary working up gives 2-(trans,trans-4'-butyl-bicyclohex-4-yl)-5-pentyl-pyrimidine.

The following compounds are prepared analogously:

2-(trans,trans-4'-butyl-bicyclohex-4-yl)-5-ethylpyrimidine
2-(trans,trans-4'-butyl-bicyclohex-4-yl)-5-propylpyrimidine
2-(trans,trans-4'-butyl-bicyclohex-4-yl)-5-butylpyrimidine
2-(trans,trans-4'-butyl-bicyclohex-4-yl)-5-heptylpyrimidine,

m.p. 46°; S/N 137°; c.p. 147°; Δε 3.20

2-(trans,trans-4'-ethyl-bicyclohex-4-yl)-5-ethylpyrimidine
2-(trans,trans-4'-ethyl-bicyclohex-4-yl)-5-propylpyrimidine
2-(trans,trans-4'-ethyl-bicyclohex-4-yl)-5-butylpyrimidine
2-(trans,trans-4'-ethyl-bicyclohex-4-yl)-5-pentylpyrimidine
2-(trans,trans-4'-ethyl-bicyclohex-4-yl)-5-heptylpyrimidine
2-(trans,trans-4'-ethyl-bicyclohex-4-yl)-5-methoxypyrimidine
2-(trans,trans-4'-ethyl-bicyclohex-4-yl)-5-ethoxypyrimidine
2-(trans,trans-4'-ethyl-bicyclohex-4-yl)-5-propoxypyrimidine
2-(trans,trans-4'-ethyl-bicyclohex-4-yl)-5-butoxypyrimidine
2-(trans,trans-4'-ethyl-bicyclohex-4-yl)-5-pentoxypyrimidine

2-(trans,trans-4'-ethyl-bicyclohex-4-yl)-5-heptoxypyrimidine
2-(trans,trans-4'-ethyl-bicyclohex-4-yl)-5-cyanopyrimidine

2-(trans,trans-4'-propyl-bicyclohex-4-yl)-5-ethylpyrimidine
2-(trans,trans-4'-propyl-bicyclohex-4-yl)-5-propylpyrimidine
5 2-(trans,trans-4'-propyl-bicyclohex-4-yl)-5-butylpyrimidine
2-(trans,trans-4'-propyl-bicyclohex-4-yl)-5-pentylpyrimidine
2-(trans,trans-4'-propyl-bicyclohex-4-yl)-5-heptylpyrimidine
2-(trans,trans-4'-propyl-bicyclohex-4-yl)-5-methoxypyrimidine
2-(trans,trans-4'-propyl-bicyclohex-4-yl)-5-ethoxypyrimidine
10 2-(trans,trans-4'-propyl-bicyclohex-4-yl)-5-propoxypyrimidine
2-(trans,trans-4'-propyl-bicyclohex-4-yl)-5-butoxypyrimidine
2-(trans,trans-4'-propyl-bicyclohex-4-yl)-5-pentoxypyrimidine
2-(trans,trans-4'-propyl-bicyclohex-4-yl)-5-heptoxypyrimidine
2-(trans,trans-4'-propyl-bicyclohex-4-yl)-5-cyanopyrimidine

15 2-(trans,trans-4'-pentyl-bicyclohex-4-yl)-5-ethylpyrimidine
2-(trans,trans-4'-pentyl-bicyclohex-4-yl)-5-propylpyrimidine
2-(trans,trans-4'-pentyl-bicyclohex-4-yl)-5-butylpyrimidine
2-(trans,trans-4'-pentyl-bicyclohex-4-yl)-5-pentylpyrimidine
2-(trans,trans-4'-pentyl-bicyclohex-4-yl)-5-heptylpyrimidine
20 2-(trans,trans-4'-pentyl-bicyclohex-4-yl)-5-methoxypyrimidine
2-(trans,trans-4'-pentyl-bicyclohex-4-yl)-5-ethoxypyrimidine
2-(trans,trans-4'-pentyl-bicyclohex-4-yl)-5-propoxypyrimidine
2-(trans,trans-4'-pentyl-bicyclohex-4-yl)-5-butoxypyrimidine
2-(trans,trans-4'-pentyl-bicyclohex-4-yl)-5-pentoxypyrimidine
25 2-(trans,trans-4'-pentyl-bicyclohex-4-yl)-5-heptoxypyrimidine
2-(trans,trans-4'-pentyl-bicyclohex-4-yl)-5-cyanopyrimidine

2-(trans,trans-4'-heptyl-bicyclohex-4-yl)-5-ethylpyrimidine
2-(trans,trans-4'-heptyl-bicyclohex-4-yl)-5-propylpyrimidine
2-(trans,trans-4'-heptyl-bicyclohex-4-yl)-5-butylpyrimidine
30 2-(trans,trans-4'-heptyl-bicyclohex-4-yl)-5-pentylpyrimidine
2-(trans,trans-4'-heptyl-bicyclohex-4-yl)-5-heptylpyrimidine
2-(trans,trans-4'-heptyl-bicyclohex-4-yl)-5-methoxypyrimidine
2-(trans,trans-4'-heptyl-bicyclohex-4-yl)-5-ethoxypyrimidine
2-(trans,trans-4'-heptyl-bicyclohex-4-yl)-5-propoxypyrimidine
35 2-(trans,trans-4'-heptyl-bicyclohex-4-yl)-5-butoxypyrimidine
2-(trans,trans-4'-heptyl-bicyclohex-4-yl)-5-pentoxypyrimidine

2-(trans,trans-4'-heptyl-bicyclohex-4-yl)-5-heptoxypyrimidine
2-(trans,trans-4'-heptyl-bicyclohex-4-yl)-5-cyanopyrimidine

Example 2

2-[4-(2-trans-4-propylcyclohexylethyl)-phenyl]-
5-pentyl-pyrimidine is prepared analogously to Example 1
from 4-(2-trans-4-propylcyclohexyl-ethyl)-benzonitrile,
which is known, via the corresponding carboximic acid
ethyl ester hydrochloride and the carboximide-amide
hydrochloride.

10 The following compounds are prepared analogously:

2-[4-(2-trans-4-propylcyclohexylethyl)-phenyl]-5-ethylpyrimidine
2-[4-(2-trans-4-propylcyclohexylethyl)-phenyl]-5-propylpyrimidine
2-[4-(2-trans-4-propylcyclohexylethyl)-phenyl]-5-butylpyrimidine
2-[4-(2-trans-4-propylcyclohexylethyl)-phenyl]-5-heptylpyrimidine

15 m.p. 99°; c.p. 138°; Δε 1.90

20 2-[4-(2-trans-4-propylcyclohexylethyl)-phenyl]-5-ethoxypyrimidine
2-[4-(2-trans-4-propylcyclohexylethyl)-phenyl]-5-propoxypyrimidine
2-[4-(2-trans-4-propylcyclohexylethyl)-phenyl]-5-pentyloxypyrimidine
2-[4-(2-trans-4-propylcyclohexylethyl)-phenyl]-5-nonyloxypyrimidine
2-[4-(2-trans-4-propylcyclohexylethyl)-phenyl]-5-cyanopyrimidine

2-[4-(2-trans-4-ethylcyclohexylethyl)-phenyl]-5-ethylpyrimidine
2-[4-(2-trans-4-ethylcyclohexylethyl)-phenyl]-5-propylpyrimidine
2-[4-(2-trans-4-ethylcyclohexylethyl)-phenyl]-5-butylpyrimidine
2-[4-(2-trans-4-ethylcyclohexylethyl)-phenyl]-5-pentylpyrimidine
25 2-[4-(2-trans-4-ethylcyclohexylethyl)-phenyl]-5-heptylpyrimidine
2-[4-(2-trans-4-ethylcyclohexylethyl)-phenyl]-5-nonylpyrimidine
2-[4-(2-trans-4-ethylcyclohexylethyl)-phenyl]-5-ethoxypyrimidine
2-[4-(2-trans-4-ethylcyclohexylethyl)-phenyl]-5-methoxypyrimidine
2-[4-(2-trans-4-ethylcyclohexylethyl)-phenyl]-5-propoxypyrimidine
30 2-[4-(2-trans-4-ethylcyclohexylethyl)-phenyl]-5-butoxypyrimidine
2-[4-(2-trans-4-ethylcyclohexylethyl)-phenyl]-5-pentoxypyrimidine
2-[4-(2-trans-4-ethylcyclohexylethyl)-phenyl]-5-hexoxypyrimidine
2-[4-(2-trans-4-ethylcyclohexylethyl)-phenyl]-5-nonoxypyrimidine
2-[4-(2-trans-4-ethylcyclohexylethyl)-phenyl]-5-cyanopyrimidine

35 2-[4-(2-trans-4-butylcyclohexylethyl)-phenyl]-5-ethylpyrimidine
2-[4-(2-trans-4-butylcyclohexylethyl)-phenyl]-5-propylpyrimidine

- 2-[4-(2-trans-4-butylcyclohexylethyl)-phenyl]-5-butylpyrimidine
2-[4-(2-trans-4-butylcyclohexylethyl)-phenyl]-5-pentylpyrimidine
2-[4-(2-trans-4-butylcyclohexylethyl)-phenyl]-5-heptylpyrimidine
2-[4-(2-trans-4-butylcyclohexylethyl)-phenyl]-5-nonylpyrimidine
5 2-[4-(2-trans-4-butylcyclohexylethyl)-phenyl]-5-ethoxypyrimidine
2-[4-(2-trans-4-butylcyclohexylethyl)-phenyl]-5-methoxypyrimidine
2-[4-(2-trans-4-butylcyclohexylethyl)-phenyl]-5-propoxypyrimidine
2-[4-(2-trans-4-butylcyclohexylethyl)-phenyl]-5-butoxypyrimidine
2-[4-(2-trans-4-butylcyclohexylethyl)-phenyl]-5-pentoxypyrimidine
10 2-[4-(2-trans-4-butylcyclohexylethyl)-phenyl]-5-hexoxypyrimidine
2-[4-(2-trans-4-butylcyclohexylethyl)-phenyl]-5-nonoxypyrimidine
2-[4-(2-trans-4-butylcyclohexylethyl)-phenyl]-5-cyanopyrimidine
- 2-[4-(2-trans-4-pentylcyclohexylethyl)-phenyl]-5-ethylpyrimidine
2-[4-(2-trans-4-pentylcyclohexylethyl)-phenyl]-5-propylpyrimidine
15 2-[4-(2-trans-4-pentylcyclohexylethyl)-phenyl]-5-butylpyrimidine
2-[4-(2-trans-4-pentylcyclohexylethyl)-phenyl]-5-pentylpyrimidine
2-[4-(2-trans-4-pentylcyclohexylethyl)-phenyl]-5-heptylpyrimidine
2-[4-(2-trans-4-pentylcyclohexylethyl)-phenyl]-5-nonylpyrimidine
2-[4-(2-trans-4-pentylcyclohexylethyl)-phenyl]-5-ethoxypyrimidine
20 2-[4-(2-trans-4-pentylcyclohexylethyl)-phenyl]-5-methoxypyrimidine
2-[4-(2-trans-4-pentylcyclohexylethyl)-phenyl]-5-propoxypyrimidine
2-[4-(2-trans-4-pentylcyclohexylethyl)-phenyl]-5-butoxypyrimidine
2-[4-(2-trans-4-pentylcyclohexylethyl)-phenyl]-5-pentoxypyrimidine
2-[4-(2-trans-4-pentylcyclohexylethyl)-phenyl]-5-hexoxypyrimidine
25 2-[4-(2-trans-4-pentylcyclohexylethyl)-phenyl]-5-nonoxypyrimidine
2-[4-(2-trans-4-pentylcyclohexylethyl)-phenyl]-5-cyanopyrimidine
- 2-[4-(2-trans-4-heptylcyclohexylethyl)-phenyl]-5-ethylpyrimidine
2-[4-(2-trans-4-heptylcyclohexylethyl)-phenyl]-5-propylpyrimidine
2-[4-(2-trans-4-heptylcyclohexylethyl)-phenyl]-5-butylpyrimidine
30 2-[4-(2-trans-4-heptylcyclohexylethyl)-phenyl]-5-pentylpyrimidine
2-[4-(2-trans-4-heptylcyclohexylethyl)-phenyl]-5-heptylpyrimidine
2-[4-(2-trans-4-heptylcyclohexylethyl)-phenyl]-5-nonylpyrimidine
2-[4-(2-trans-4-heptylcyclohexylethyl)-phenyl]-5-ethoxypyrimidine
2-[4-(2-trans-4-heptylcyclohexylethyl)-phenyl]-5-methoxypyrimidine
35 2-[4-(2-trans-4-heptylcyclohexylethyl)-phenyl]-5-propoxypyrimidine
2-[4-(2-trans-4-heptylcyclohexylethyl)-phenyl]-5-butoxypyrimidine
2-[4-(2-trans-4-heptylcyclohexylethyl)-phenyl]-5-pentoxypyrimidine

- 2-[4-(2-trans-4-heptylcyclohexylethyl)-phenyl]-5-hexoxypyrimidine
2-[4-(2-trans-4-heptylcyclohexylethyl)-phenyl]-5-nonoxypyrimidine
2-[4-(2-trans-4-heptylcyclohexylethyl)-phenyl]-5-cyanopyrimidine
- 2-p-cyanophenyl-5-[2-(trans-4-nonylcyclohexyl)-ethyl]-pyrimidine
- 5 2-p-fluorophenyl-5-[2-(trans-4-ethylcyclohexyl)-ethyl]-pyrimidine
2-p-fluorophenyl-5-[2-(trans-4-propylcyclohexyl)-ethyl]-pyrimidine
2-p-fluorophenyl-5-[2-(trans-4-butylcyclohexyl)-ethyl]-pyrimidine
2-p-fluorophenyl-5-[2-(trans-4-pentylcyclohexyl)-ethyl]-pyrimidine
2-p-fluorophenyl-5-[2-(trans-4-heptylcyclohexyl)-ethyl]-pyrimidine
- 10 2-p-fluorophenyl-5-[2-(trans-4-nonylcyclohexyl)-ethyl]-pyrimidine
- 2-p-ethylphenyl-5-[2-(trans-4-ethylcyclohexyl)-ethyl]-pyrimidine
2-p-ethylphenyl-5-[2-(trans-4-propylcyclohexyl)-ethyl]-pyrimidine
2-p-ethylphenyl-5-[2-(trans-4-butylcyclohexyl)-ethyl]-pyrimidine
2-p-ethylphenyl-5-[2-(trans-4-pentylcyclohexyl)-ethyl]-pyrimidine
- 15 2-p-ethylphenyl-5-[2-(trans-4-heptylcyclohexyl)-ethyl]-pyrimidine
2-p-ethylphenyl-5-[2-(trans-4-nonylcyclohexyl)-ethyl]-pyrimidine
- 2-p-butylphenyl-5-[2-(trans-4-ethylcyclohexyl)-ethyl]-pyrimidine
2-p-butylphenyl-5-[2-(trans-4-propylcyclohexyl)-ethyl]-pyrimidine
2-p-butylphenyl-5-[2-(trans-4-butylcyclohexyl)-ethyl]-pyrimidine
- 20 2-p-butylphenyl-5-[2-(trans-4-pentylcyclohexyl)-ethyl]-pyrimidine
2-p-butylphenyl-5-[2-(trans-4-heptylcyclohexyl)-ethyl]-pyrimidine
2-p-butylphenyl-5-[2-(trans-4-nonylcyclohexyl)-ethyl]-pyrimidine
- 2-p-pentylphenyl-5-[2-(trans-4-ethylcyclohexyl)-ethyl]-pyrimidine
2-p-pentylphenyl-5-[2-(trans-4-propylcyclohexyl)-ethyl]-pyrimidine
- 25 2-p-pentylphenyl-5-[2-(trans-4-butylcyclohexyl)-ethyl]-pyrimidine
2-p-pentylphenyl-5-[2-(trans-4-pentylcyclohexyl)-ethyl]-pyrimidine
2-p-pentylphenyl-5-[2-(trans-4-heptylcyclohexyl)-ethyl]-pyrimidine
2-p-pentylphenyl-5-[2-(trans-4-nonylcyclohexyl)-ethyl]-pyrimidine
- 2-p-heptylphenyl-5-[2-(trans-4-ethylcyclohexyl)-ethyl]-pyrimidine
- 30 2-p-heptylphenyl-5-[2-(trans-4-propylcyclohexyl)-ethyl]-pyrimidine
2-p-heptylphenyl-5-[2-(trans-4-butylcyclohexyl)-ethyl]-pyrimidine
2-p-heptylphenyl-5-[2-(trans-4-pentylcyclohexyl)-ethyl]-pyrimidine
2-p-heptylphenyl-5-[2-(trans-4-heptylcyclohexyl)-ethyl]-pyrimidine

- 2-p-heptylphenyl-5-[2-(trans-4-nonylcyclohexyl)-ethyl]-pyrimidine
- 5 2-p-hexylphenyl-5-[2-(trans-4-ethylcyclohexyl)-ethyl]-pyrimidine
2-p-hexylphenyl-5-[2-(trans-4-propylcyclohexyl)-ethyl]-pyrimidine
2-p-hexylphenyl-5-[2-(trans-4-butylcyclohexyl)-ethyl]-pyrimidine
2-p-hexylphenyl-5-[2-(trans-4-pentylcyclohexyl)-ethyl]-pyrimidine
2-p-hexylphenyl-5-[2-(trans-4-heptylcyclohexyl)-ethyl]-pyrimidine
2-p-hexylphenyl-5-[2-(trans-4-nonylcyclohexyl)-ethyl]-pyrimidine
- 10 2-p-nonylphenyl-5-[2-(trans-4-ethylcyclohexyl)-ethyl]-pyrimidine
2-p-nonylphenyl-5-[2-(trans-4-propylcyclohexyl)-ethyl]-pyrimidine
2-p-nonylphenyl-5-[2-(trans-4-butylcyclohexyl)-ethyl]-pyrimidine
2-p-nonylphenyl-5-[2-(trans-4-pentylcyclohexyl)-ethyl]-pyrimidine
2-p-nonylphenyl-5-[2-(trans-4-heptylcyclohexyl)-ethyl]-pyrimidine
2-p-nonylphenyl-5-[2-(trans-4-nonylcyclohexyl)-ethyl]-pyrimidine
- 15 2-p-methoxyphenyl-5-[2-(trans-4-ethylcyclohexyl)-ethyl]-pyrimidine
2-p-methoxyphenyl-5-[2-(trans-4-propylcyclohexyl)-ethyl]-pyrimidine
2-p-methoxyphenyl-5-[2-(trans-4-butylcyclohexyl)-ethyl]-pyrimidine
2-p-methoxyphenyl-5-[2-(trans-4-pentylcyclohexyl)-ethyl]-pyrimidine
2-p-methoxyphenyl-5-[2-(trans-4-heptylcyclohexyl)-ethyl]-pyrimidine
2-p-methoxyphenyl-5-[2-(trans-4-nonylcyclohexyl)-ethyl]-pyrimidine
- 20 2-p-pentoxyphenyl-5-[2-(trans-4-ethylcyclohexyl)-ethyl]-pyrimidine
2-p-pentoxyphenyl-5-[2-(trans-4-propylcyclohexyl)-ethyl]-pyrimidine
2-p-pentoxyphenyl-5-[2-(trans-4-butylcyclohexyl)-ethyl]-pyrimidine
2-p-pentoxyphenyl-5-[2-(trans-4-pentylcyclohexyl)-ethyl]-pyrimidine
2-p-pentoxyphenyl-5-[2-(trans-4-heptylcyclohexyl)-ethyl]-pyrimidine
- 25 2-p-pentoxyphenyl-5-[2-(trans-4-nonylcyclohexyl)-ethyl]-pyrimidine
- 30 2-p-hexoxyphenyl-5-[2-(trans-4-ethylcyclohexyl)-ethyl]-pyrimidine
2-p-hexoxyphenyl-5-[2-(trans-4-propylcyclohexyl)-ethyl]-pyrimidine
2-p-hexoxyphenyl-5-[2-(trans-4-butylcyclohexyl)-ethyl]-pyrimidine
2-p-hexoxyphenyl-5-[2-(trans-4-pentylcyclohexyl)-ethyl]-pyrimidine
2-p-hexoxyphenyl-5-[2-(trans-4-heptylcyclohexyl)-ethyl]-pyrimidine
2-p-hexoxyphenyl-5-[2-(trans-4-nonylcyclohexyl)-ethyl]-pyrimidine
- 2-p-heptoxyphenyl-5-[2-(trans-4-ethylcyclohexyl)-ethyl]-pyrimidine
2-p-heptoxyphenyl-5-[2-(trans-4-propylcyclohexyl)-ethyl]-pyrimidine

- 2-p-heptoxyphenyl-5-[2-(trans-4-butylcyclohexyl)-ethyl]-pyrimidine
2-p-heptoxyphenyl-5-[2-(trans-4-pentylcyclohexyl)-ethyl]-pyrimidine
2-p-heptoxyphenyl-5-[2-(trans-4-heptylcyclohexyl)-ethyl]-pyrimidine
2-p-heptoxyphenyl-5-[2-(trans-4-nonylcyclohexyl)-ethyl]-pyrimidine
- 5 2-p-octoxyphenyl-5-[2-(trans-4-ethylcyclohexyl)-ethyl]-pyrimidine
2-p-octoxyphenyl-5-[2-(trans-4-propylcyclohexyl)-ethyl]-pyrimidine
2-p-octoxyphenyl-5-[2-(trans-4-butylcyclohexyl)-ethyl]-pyrimidine
2-p-octoxyphenyl-5-[2-(trans-4-pentylcyclohexyl)-ethyl]-pyrimidine
2-p-octoxyphenyl-5-[2-(trans-4-heptylcyclohexyl)-ethyl]-pyrimidine
- 10 2-p-octoxyphenyl-5-[2-(trans-4-nonylcyclohexyl)-ethyl]-pyrimidine
- 2-p-nonoxoxyphenyl-5-[2-(trans-4-ethylcyclohexyl)-ethyl]-pyrimidine
2-p-nonoxoxyphenyl-5-[2-(trans-4-propylcyclohexyl)-ethyl]-pyrimidine
2-p-nonoxoxyphenyl-5-[2-(trans-4-butylcyclohexyl)-ethyl]-pyrimidine
2-p-nonoxoxyphenyl-5-[2-(trans-4-pentylcyclohexyl)-ethyl]-pyrimidine
- 15 2-p-nonoxoxyphenyl-5-[2-(trans-4-heptylcyclohexyl)-ethyl]-pyrimidine
2-p-nonoxoxyphenyl-5-[2-(trans-4-nonylcyclohexyl)-ethyl]-pyrimidine
- 2-p-decoxyphenyl-5-[2-(trans-4-ethylcyclohexyl)-ethyl]-pyrimidine
2-p-decoxyphenyl-5-[2-(trans-4-propylcyclohexyl)-ethyl]-pyrimidine
2-p-decoxyphenyl-5-[2-(trans-4-butylcyclohexyl)-ethyl]-pyrimidine
- 20 2-p-decoxyphenyl-5-[2-(trans-4-pentylcyclohexyl)-ethyl]-pyrimidine
2-p-decoxyphenyl-5-[2-(trans-4-heptylcyclohexyl)-ethyl]-pyrimidine
2-p-decoxyphenyl-5-[2-(trans-4-nonylcyclohexyl)-ethyl]-pyrimidine
- 2-p-undecoxyphenyl-5-[2-(trans-4-ethylcyclohexyl)-ethyl]-pyrimidine
2-p-undecoxyphenyl-5-[2-(trans-4-propylcyclohexyl)-ethyl]-pyrimidine
- 25 2-p-undecoxyphenyl-5-[2-(trans-4-butylcyclohexyl)-ethyl]-pyrimidine
2-p-undecoxyphenyl-5-[2-(trans-4-pentylcyclohexyl)-ethyl]-pyrimidine
2-p-undecoxyphenyl-5-[2-(trans-4-heptylcyclohexyl)-ethyl]-pyrimidine
2-p-undecoxyphenyl-5-[2-(trans-4-nonylcyclohexyl)-ethyl]-pyrimidine
- 2-p-dodecoxyphenyl-5-[2-(trans-4-ethylcyclohexyl)-ethyl]-pyrimidine
2-p-dodecoxyphenyl-5-[2-(trans-4-propylcyclohexyl)-ethyl]-pyrimidine
- 30 2-p-dodecoxyphenyl-5-[2-(trans-4-butylcyclohexyl)-ethyl]-pyrimidine
2-p-dodecoxyphenyl-5-[2-(trans-4-pentylcyclohexyl)-ethyl]-pyrimidine
2-p-dodecoxyphenyl-5-[2-(trans-4-heptylcyclohexyl)-ethyl]-pyrimidine
2-p-dodecoxyphenyl-5-[2-(trans-4-nonylcyclohexyl)-ethyl]-pyrimidine

- 2-(trans-4-pentylcyclohexyl)-5-[2-(p-cyanophenyl)-ethyl]-pyrimidine
2-(trans-4-pentylcyclohexyl)-5-[2-(p-methoxyphenyl)-ethyl]-pyrimidine
2-(trans-4-pentylcyclohexyl)-5-[2-(p-propoxyphenyl)-ethyl]-pyrimidine
2-(trans-4-pentylcyclohexyl)-5-[2-(p-pentoxyphenyl)-ethyl]-pyrimidine
5 2-(trans-4-pentylcyclohexyl)-5-[2-(p-heptoxyphenyl)-ethyl]-pyrimidine
2-(trans-4-pentylcyclohexyl)-5-[2-(p-nonoxyphehyl)-ethyl]-pyrimidine
2-(trans-4-pentylcyclohexyl)-5-[2-(p-decoxyphenyl)-ethyl]-pyrimidine
2-(trans-4-pentylcyclohexyl)-5-[2-(p-dodecoxyphenyl)-ethyl]-pyrimidine
10 2-(trans-4-pentylcyclohexyl)-5-[2-(p-ethylphenyl)-ethyl]-pyrimidine
2-(trans-4-pentylcyclohexyl)-5-[2-(p-propylphenyl)-ethyl]-pyrimidine
2-(trans-4-pentylcyclohexyl)-5-[2-(p-butylphenyl)-ethyl]-pyrimidine
2-(trans-4-pentylcyclohexyl)-5-[2-(p-pentylphenyl)-ethyl]-pyrimidine
2-(trans-4-pentylcyclohexyl)-5-[2-(p-heptylphenyl)-ethyl]-pyrimidine
15 2-(trans-4-pentylcyclohexyl)-5-[2-(p-nonylphenyl)-ethyl]-pyrimidine

Example 3

28 g of diethyl trans-4-propylcyclohexyl-malonate and a suspension of 20 g of 4-ethoxy-benzocarbonyl-imide hydrochloride in 50 ml of ethanol are added in succession to a sodium ethanolate solution prepared from 6.9 g of sodium and 200 ml of ethanol. After the reaction mixture has been stirred for 8 hours, it is poured into 500 ml of ice-water and neutralized with dilute hydrochloric acid. Extraction with several portions of methylene chloride and subsequent removal of the solvent by distillation gives a residue, which is recrystallized twice from ethanol. Yield: 23 g of 4,6-dihydroxy-2-(4-ethoxyphenyl)-5-(trans-4-propylcyclohexyl)-pyrimidine.

22 g of the dihydroxypyrimidine are heated under reflux with 19 g of N,N-diethylaniline and 80 ml of phosphorus oxytrichloride for 48 hours. The cooled reaction solution is poured onto ice. After extraction with methylene chloride and subsequent removal of the solvent by distillation, the residue which remains, consisting of 4,6-dichloro-2-(4-ethoxyphenyl)-5-(trans-4-propylcyclohexyl)-pyrimidine, is dissolved in 300 ml of methanol and, after addition of palladium-on-charcoal (5% of Pd) is hydrogenated at room temperature. The catalyst is

removed by filtration, the solvent is distilled off and the residue is subjected to separation by column chromatography (silica gel/toluene). 2-(4-Ethoxyphenyl)-5-(trans-4-propylcyclohexyl)-pyrimidine is obtained from the main fraction, after removal of the solvent and customary working up.

The following compounds are prepared analogously:

2-(4-ethoxyphenyl)-5-(trans-4-ethylcyclohexyl)-pyrimidine
2-(4-ethoxyphenyl)-5-(trans-4-butylcyclohexyl)-pyrimidine
10 2-(4-ethoxyphenyl)-5-(trans-4-pentylcyclohexyl)-pyrimidine
2-(4-ethoxyphenyl)-5-(trans-4-heptylcyclohexyl)-pyrimidine

2-(4-methoxyphenyl)-5-(trans-4-ethylcyclohexyl)-pyrimidine
2-(4-methoxyphenyl)-5-(trans-4-propylcyclohexyl)-pyrimidine
2-(4-methoxyphenyl)-5-(trans-4-butylcyclohexyl)-pyrimidine
15 2-(4-methoxyphenyl)-5-(trans-4-pentylcyclohexyl)-pyrimidine
2-(4-methoxyphenyl)-5-(trans-4-heptylcyclohexyl)-pyrimidine

2-(4-propoxyphenyl)-5-(trans-4-ethylcyclohexyl)-pyrimidine
2-(4-propoxyphenyl)-5-(trans-4-propylcyclohexyl)-pyrimidine
2-(4-propoxyphenyl)-5-(trans-4-butylcyclohexyl)-pyrimidine
20 2-(4-propoxyphenyl)-5-(trans-4-pentylcyclohexyl)-pyrimidine
2-(4-propoxyphenyl)-5-(trans-4-heptylcyclohexyl)-pyrimidine

2-(4-butoxyphenyl)-5-(trans-4-ethylcyclohexyl)-pyrimidine
2-(4-butoxyphenyl)-5-(trans-4-propylcyclohexyl)-pyrimidine
2-(4-butoxyphenyl)-5-(trans-4-butylcyclohexyl)-pyrimidine
25 2-(4-butoxyphenyl)-5-(trans-4-pentylcyclohexyl)-pyrimidine
2-(4-butoxyphenyl)-5-(trans-4-hexylcyclohexyl)-pyrimidine
m.p. 75°, c.p. 196°
2-(4-butoxyphenyl)-5-(trans-4-heptylcyclohexyl)-pyrimidine

2-(4-pentoxyphehyl)-5-(trans-4-ethylcyclohexyl)-pyrimidine
30 2-(4-pentoxyphehyl)-5-(trans-4-propylcyclohexyl)-pyrimidine
2-(4-pentoxyphehyl)-5-(trans-4-butylcyclohexyl)-pyrimidine
2-(4-pentoxyphehyl)-5-(trans-4-pentylcyclohexyl)-pyrimidine
2-(4-pentoxyphehyl)-5-(trans-4-heptylcyclohexyl)-pyrimidine

2-(4-hexoxyphenyl)-5-(trans-4-ethylcyclohexyl)-pyrimidine

- 2-(4-hexoxyphenyl)-5-(trans-4-propylcyclohexyl)-pyrimidine
2-(4-hexoxyphenyl)-5-(trans-4-butylcyclohexyl)-pyrimidine
2-(4-hexoxyphenyl)-5-(trans-4-pentylcyclohexyl)-pyrimidine
2-(4-hexoxyphenyl)-5-(trans-4-heptylcyclohexyl)-pyrimidine
- 5 2-(4-heptoxyphenyl)-5-(trans-4-ethylcyclohexyl)-pyrimidine
2-(4-heptoxyphenyl)-5-(trans-4-propylcyclohexyl)-pyrimidine
2-(4-heptoxyphenyl)-5-(trans-4-butylcyclohexyl)-pyrimidine
2-(4-heptoxyphenyl)-5-(trans-4-pentylcyclohexyl)-pyrimidine
2-(4-heptoxyphenyl)-5-(trans-4-heptylcyclohexyl)-pyrimidine
- 10 2-(4-nonoxyphenyl)-5-(trans-4-ethylcyclohexyl)-pyrimidine
2-(4-nonoxyphenyl)-5-(trans-4-propylcyclohexyl)-pyrimidine
2-(4-nonoxyphenyl)-5-(trans-4-butylcyclohexyl)-pyrimidine
2-(4-nonoxyphenyl)-5-(trans-4-pentylcyclohexyl)-pyrimidine
2-(4-nonoxyphenyl)-5-(trans-4-heptylcyclohexyl)-pyrimidine
- 15 2-(4-undecyloxyphenyl)-5-(trans-4-ethylcyclohexyl)-pyrimidine
2-(4-undecyloxyphenyl)-5-(trans-4-propylcyclohexyl)-pyrimidine
2-(4-undecyloxyphenyl)-5-(trans-4-butylcyclohexyl)-pyrimidine
2-(4-undecyloxyphenyl)-5-(trans-4-pentylcyclohexyl)-pyrimidine
2-(4-undecyloxyphenyl)-5-(trans-4-heptylcyclohexyl)-pyrimidine
- 20 2-(4-dodecyloxyphenyl)-5-(trans-4-ethylcyclohexyl)-pyrimidine
2-(4-dodecyloxyphenyl)-5-(trans-4-propylcyclohexyl)-pyrimidine
2-(4-dodecyloxyphenyl)-5-(trans-4-butylcyclohexyl)-pyrimidine
2-(4-dodecyloxyphenyl)-5-(trans-4-pentylcyclohexyl)-pyrimidine
2-(4-dodecyloxyphenyl)-5-(trans-4-heptylcyclohexyl)-pyrimidine
- 25 Example 4
- 30 A mixture of 11 g of 2-p-hydroxyphenyl-5-n-hexylpyrimidine, 7.8 g of trans-4-n-propyl-1-bromomethylcyclohexane, 8.6 g of potassium carbonate and 50 ml of dimethylformamide is warmed to 90° for 10 hours. Customary working up gives 4-(5-n-hexylpyrimidin-2-yl)-phenyl trans-4-n-propylcyclohexylmethyl ether.
- The following compounds are prepared analogously:
4-(5-hexylpyrimidin-2-yl)-phenyl trans-4-ethylcyclohexylmethyl ether
4-(5-hexylpyrimidin-2-yl)-phenyl trans-4-butylcyclohexylmethyl ether

4-(5-hexylpyrimidin-2-yl)-phenyl trans-4-pentylcyclohexylmethyl ether,
m.p. 99°, c.p. 150°

4-(5-hexylpyrimidin-2-yl)-phenyl trans-4-heptylcyclohexylmethyl ether

5 4-(5-heptylpyrimidin-2-yl)-phenyl trans-4-ethylcyclohexylmethyl ether
4-(5-heptylpyrimidin-2-yl)-phenyl trans-4-propylcyclohexylmethyl ether
4-(5-heptylpyrimidin-2-yl)-phenyl trans-4-butylcyclohexylmethyl ether
4-(5-heptylpyrimidin-2-yl)-phenyl trans-4-pentylcyclohexylmethyl ether
4-(5-heptylpyrimidin-2-yl)-phenyl trans-4-heptylcyclohexylmethyl ether

10 4-(5-nonylpyrimidin-2-yl)-phenyl trans-4-ethylcyclohexylmethyl ether
4-(5-nonylpyrimidin-2-yl)-phenyl trans-4-propylcyclohexylmethyl ether
4-(5-nonylpyrimidin-2-yl)-phenyl trans-4-butylcyclohexylmethyl ether
4-(5-nonylpyrimidin-2-yl)-phenyl trans-4-pentylcyclohexylmethyl ether
4-(5-nonylpyrimidin-2-yl)-phenyl trans-4-heptylcyclohexylmethyl ether

15 4-(5-pentylpyrimidin-2-yl)-phenyl trans-4-ethylcyclohexylmethyl ether
4-(5-pentylpyrimidin-2-yl)-phenyl trans-4-propylcyclohexylmethyl ether
4-(5-pentylpyrimidin-2-yl)-phenyl trans-4-butylcyclohexylmethyl ether
4-(5-pentylpyrimidin-2-yl)-phenyl trans-4-pentylcyclohexylmethyl ether
4-(5-pentylpyrimidin-2-yl)-phenyl trans-4-heptylcyclohexylmethyl ether

20 4-(5-propylpyrimidin-2-yl)-phenyl trans-4-ethylcyclohexylmethyl ether
4-(5-propylpyrimidin-2-yl)-phenyl trans-4-propylcyclohexylmethyl ether
4-(5-propylpyrimidin-2-yl)-phenyl trans-4-butylcyclohexylmethyl ether
4-(5-propylpyrimidin-2-yl)-phenyl trans-4-pentylcyclohexylmethyl ether
4-(5-propylpyrimidin-2-yl)-phenyl trans-4-heptylcyclohexylmethyl ether

25 The following examples relate to liquid crystal phases
according to the invention:

Example A

30 A liquid crystal phase is prepared from
17% of p-trans-4-propylcyclohexyl-benzonitrile,
23% of p-trans-4-pentylcyclohexyl-benzonitrile,
16% of trans-1-p-ethoxyphenyl-4-propylcyclohexane,
14% of trans-1-p-butoxyphenyl-4-propylcyclohexane,
10% of 4-(trans-4-pentylcyclohexyl)-4'-(trans-4-propylcyclohexyl)-
biphenyl,
10% of 2-(4-ethoxyphenyl)-5-(trans-4-propylcyclohexyl)-pyrimidine

and

10% of 2-(4-methoxyphenyl)-5-(trans-4-pentylcyclohexyl)-pyrimidine.

Example B

A liquid crystal phase is prepared from

- 5 21% of p-trans-4-ethylcyclohexyl-benzonitrile,
22% of p-trans-4-butylcyclohexyl-benzonitrile,
24% of 4-ethyl-4'-cyanobiphenyl,
18% of 4-butyl-4'-cyanobiphenyl,
10% of p-pentylphenyl 2-(trans-4-propylcyclohexyl)-pyrimidine-5-
10 carboxylate and
15% of 2-[trans-4-(trans-5-propyl-1,3-dioxan-2-yl)-cyclohexyl]-5-
pentylpyrimidine.

Example C

A liquid crystal phase consisting of

- 15 8% of 2-p-cyanophenyl-5-butyl-1,3-dioxane,
7% of 2-p-cyanophenyl-5-pentyl-1,3-dioxane,
8% of 4-cyano-4'-(trans-4-pentylcyclohexyl)-biphenyl,
5% of 4-ethyl-4'-(trans-4-pentylcyclohexyl)-biphenyl,
5% of 2-(4-ethoxyphenyl)-5-(trans-4-propylcyclohexyl)-pyrimidine,
20 5% of 2-p-pentoxyphenyl-5-hexylpyrimidine,
5% of 2-p-hexoxyphenyl-5-hexylpyrimidine,
6% of 2-p-heptoxyphenyl-5-hexylpyrimidine,
8% of 2-p-nonoxyphenyl-5-hexylpyrimidine,
8% of 2-p-undecoxyphenyl-5-hexylpyrimidine,
25 7% of p-methoxyphenyl trans-4-propylcyclohexanecarboxylate,
7% of p-ethoxyphenyl trans-4-propylcyclohexanecarboxylate,
7% of p-methoxyphenyl trans-4-butylcyclohexanecarboxylate,
7% of p-ethoxyphenyl trans-4-butylcyclohexanecarboxylate, and
7% of p-methoxyphenyl trans-4-pentylcyclohexanecarboxylate,
30 has a viscosity of 49×10^{-3} Pa.s and is particularly
suitable for liquid crystal display elements of high
multiplexing capacity.

Example D

A liquid crystal phase consisting of

- 35 8.0% of trans-1-p-propylphenyl-4-pentylcyclohexane,
7.0% of 2-p-cyanophenyl-5-propyl-1,3-dioxane,
8.0% of 2-p-cyanophenyl-5-butyl-1,3-dioxane,
7.0% of 2-p-cyanophenyl-5-pentyl-1,3-dioxane,
7.5% of 4-cyano-4'-(trans-4-pentylcyclohexyl)-biphenyl,

5.0% of 4-ethyl-4'-(trans-4-pentylcyclohexyl)-biphenyl,
5.0% of 4-ethyl-4'-(trans-4-propylcyclohexyl)-biphenyl,
5.0% of 2-p-pentoxyphenyl-5-hexylpyrimidine,
5.0% of 2-p-hexoxyphenyl-5-hexylpyrimidine,
5 6.0% of 2-p-heptoxyphenyl-5-hexylpyrimidine,
8.0% of 2-p-nonoxyphenyl-5-hexylpyrimidine,
8.0% of 2-p-undecyloxyphenyl-5-hexylpyrimidine,
0.5% of 2-(trans,trans-4'-butyl-bicyclohex-4-yl)-5-pentylpyrimidine,
7.0% of p-methoxyphenyl trans-4-propylcyclohexanecarboxylate,
10 7.0% of p-ethoxyphenyl trans-4-propylcyclohexanecarboxylate, and
6.0% of p-methoxyphenyl trans-4-butylcyclohexanecarboxylate,
has a clear point of 64° and a viscosity of 45×10^{-3} Pa.s
and is particularly suitable for liquid crystal display
elements of high multiplexing capacity.

15 Example E

A liquid crystal phase consisting of
7% of 2-p-cyanophenyl-5-propyl-1,3-dioxane,
6% of 2-p-cyanophenyl-5-butyl-1,3-dioxane,
5% of 2-p-cyanophenyl-5-pentyl-1,3-dioxane,
20 4% of 2-p-pentoxyphenyl-5-hexylpyrimidine,
4% of 2-p-hexoxyphenyl-5-hexylpyrimidine,
5% of 2-p-heptoxyphenyl-5-hexylpyrimidine,
7% of 2-p-nonoxyphenyl-5-hexylpyrimidine,
7% of 2-p-undecyloxyphenyl-5-hexylpyrimidine,
25 6% of p-methoxyphenyl trans-4-propylcyclohexanecarboxylate,
4% of p-methoxyphenyl trans-4-butylcyclohexanecarboxylate,
3% of p-methoxyphenyl trans-4-pentylcyclohexanecarboxylate,
9% of trans-1-p-propylphenyl-4-pentylcyclohexane,
3% of p-trans-4-propylcyclohexyl-phenyl butyrate,
30 18% of 2-(trans,trans-4'-butyl-bicyclohex-4-yl)-5-pentylpyrimidine,
9% of 2-[4-(2-trans-4-propylcyclohexylethyl)-phenyl]-5-pentyl-
pyrimidine and
3% of 2-[4-(2-trans-4-propylcyclohexylethyl)-phenyl]-5-heptyl-
pyrimidine
35 is particularly suitable for liquid crystal display
elements of high multiplexing capacity.

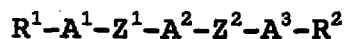
Example F

A liquid crystal phase consisting of
3% of 2-p-cyanophenyl-5-pentyl-1,3-dioxane,

6% of 4-cyano-4'-(trans-4-pentylcyclohexyl)-biphenyl,
7% of 2-[4-(2-trans-4-propylcyclohexylethyl)-phenyl]-5-pentyl-
pyrimidine,
8% of 2-[4-(2-trans-4-propylcyclohexylethyl)-phenyl]-5-heptyl-
pyrimidine,
5 5% of 2-p-octoxyphenyl-5-pentylpyrimidine,
5% of 2-p-pentoxyphenyl-5-hexylpyrimidine,
5% of 2-p-heptoxyphenyl-5-hexylpyrimidine,
4% of 2-p-nonoxypyphenyl-5-hexylpyrimidine,
10 5% of 2-p-heptoxyphenyl-5-heptylpyrimidine,
4% of 2-p-nonoxypyphenyl-5-heptylpyrimidine,
5% of 2-p-nonoxypyphenyl-5-nonylpyrimidine,
5% of p-methoxyphenyl trans-4-propylcyclohexanecarboxylate,
7% of p-methoxyphenyl trans-4-butylcyclohexanecarboxylate,
15 8% of p-methoxyphenyl trans-4-pentylcyclohexanecarboxylate,
17% of trans-1-p-propylphenyl-4-pentylcyclohexane and
6% of p-trans-4-propylcyclohexyl-phenyl butyrate
has a clear point of 65°. This mixture is particularly
suitable for liquid crystal display elements of high
20 multiplexing capacity.

Patent Claims for the Contracting States: CH, DE, GB, LI

1. Compounds of the formula I



wherein

R^1 and R^2 in each case independently of one another are an alkyl group having 1-15 C atoms, it also being possible for one or two non-adjacent CH_2 groups to be replaced by O atoms and/or -CO- groups and/or -O-CO- groups and/or -CO-O- groups, and one of the radicals R^1 and R^2 is also H, F, Cl, Br or CN,

A^1 is a 1,4-cyclohexylene group, it also being possible for one or two non-adjacent CH_2 groups to be replaced by O atoms, a 1,4-bicyclo-(2,2,2)-octylene group or a 1,3-dithiane-2,5-diyl group,

Z^1 and Z^2 in each case independently of one another are $-CH_2CH_2-$, $-OCH_2-$, $-CH_2O-$ or a single bond, and

A^2 and A^3 in each case independently of one another are a 1,4-phenylene group, pyrimidine-2,5-diyl group, 1,4-cyclohexylene group, it also being possible for one or two non-adjacent CH_2 groups to be replaced by O atoms, 1,3-dithiane-2,5-diyl group or a 1,4-bicyclo(2,2,2)-octylene group,

with the provisos that

- (a) at least one of the groups A^2 and A^3 is a pyrimidine-2,5-diyl group,
- (b) at least one of the groups Z^1 and Z^2 is not a single bond if A^2 is pyrimidine-2,5-diyl and R^2 is alkyl or CN,
- (c) 2-(4-cyanophenyl)-5-[2-(trans-4-ethylcyclohexyl)-ethyl]-pyrimidine,
2-(4-cyanophenyl)-5-[2-(trans-4-propylcyclohexyl)-ethyl]-pyrimidine,
2-(4-cyanophenyl)-5-[2-(trans-4-butylcyclohexyl)-ethyl]-pyrimidine,



2-(4-cyanophenyl)-5-[2-(trans-4-pentylcyclohexyl)-ethyl]-pyrimidine, and

2-(4-cyanophenyl)-5-[2-(trans-4-heptylcyclohexyl)-ethyl]-pyrimidine,

is (sic) excluded, and

(d) 5-alkyl-2-(4'-(trans-4"-alkylcyclohexyl)-phenyl)pyrimidines are excluded.

2. Compounds according to Claim 1, wherein R¹ and R² in each case independently of one another are a straight-chain alkyl, alkoxy or oxaalkyl group.

3. Compounds according to Claim 1 or 2, wherein A¹ is a trans-1,4-cyclohexylene group.

4. Compounds according to one of Claims 1 to 3 corresponding to the part formulae Ica, Ifi, Ifk, Ifj and Ifl

$R^1\text{-Cy-Pyr-Phe-R}^2$	Ica
$R^1\text{-Cy-Z}^1\text{-Pyr-Phe-R}^2$	Ifi
$R^1\text{-Cy-Z}^1\text{-Phe-Pyr-R}^2$	Ifk
$R^1\text{-Cy-Pyr-Z}^2\text{-Phe-R}^2$	Iij
$R^1\text{-Cy-Phe-Z}^2\text{-Pyr-R}^2$	Iil

wherein R¹ and R² have the meaning given and

Cy is a 1,4-cyclohexylene group,

Pyr is a pyrimidine-2,5-diyl group,

Phe is a 1,4-phenylene group and

Z^1 and Z^2 are $-CH_2O-$, $-OCH_2-$ or $-CH_2CH_2-$.

5. Compounds according to Claim 4 corresponding to the part formulae Ica, Ifi, Ifk, Iij and Iil, wherein R¹, Z¹, Z², Cy, Pyr and Phe have the meaning given, and R² is F.

6. Compounds according to Claim 4 or 5, wherein Z^1 or Z^2 is $-CH_2CH_2-$ or $-CH_2O-$.

7. Compounds according to Claim 3 corresponding to the part formulae

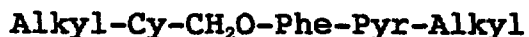
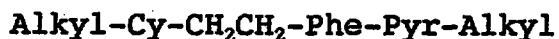
Alkyl-Cy-Cy-Pyr-Alkyl

Alkyl-Cy-Cy-Pyr-Alkoxy



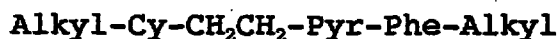
wherein Cy and Pyr have the meaning given in Claim 2 and alkyl is a straight-chain alkyl group having 2 to 10 C atoms and alkoxy is a straight-chain alkoxy group having 2 to 12 C atoms.

8. Compounds according to Claim 4 corresponding to the part formulae



wherein Cy, Phe and Pyr have the meaning given in Claim 4 and alkyl in each case is a straight-chain alkyl group having 2 to 10 C atoms.

9. Compounds according to Claim 4 corresponding to the part formulae



wherein Cy, Phe and Pyr have the meaning given in Claim 4 and alkyl in each case is a straight-chain alkyl group having 2 to 10 C atoms.

10. Process for the preparation of compounds of the formula I according to Claim 1, characterized in that a compound which otherwise corresponds to the formula I but contains one or more reducible groups and/or C-C bonds instead of H atoms is treated with a reducing agent, or in that, to prepare esters of the formula I (wherein R¹ and/or R² are an alkyl group, in which one or two CH₂ groups are replaced by -O-CO- groups and/or -CO-O- groups), a corresponding carboxylic acid or one of its reactive derivatives is reacted with a corresponding alcohol or one of its reactive derivatives, or in that, to prepare 1,3-dioxane derivatives or 1,3-dithiane derivatives of the formula I (wherein A¹ is 1,3-dioxane-2,5-diyl or 1,3-dithiane-2,5-diyl), a corresponding aldehyde is reacted with a corresponding diol or dithiol,

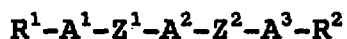


or in that, to prepare ethers of the formula I (wherein R^1 and/or R^2 are an alkyl group, in which one or two CH_2 groups are replaced by O atoms, and/or Z is an $-OCH_2-$ or $-CH_2O-$ group), a corresponding hydroxy compound is etherified.

11. Use of the compounds of the formula I according to Claim 1 as components of liquid crystal phases.

12. Liquid crystal phase containing at least two liquid crystal components, characterized in that at least one component is a compound of the formula I according to Claim 1.

13. Liquid crystal phase containing at least two liquid crystal components, characterized in that at least one component is a compound of the formula I



I

wherein R^1 , R^2 , A^1 , A^2 , A^3 , Z^1 and Z^2 have the meaning given in Claim 1,

with the provisos that

- (a) at least one of the groups A^2 and A^3 is a pyrimidine-2,5-diyl group, and
- (b) at least one of the groups Z^1 and Z^2 is not a single bond if A^2 is pyrimidine-2,5-diyl and R^2 is alkyl or CN, and
- (c) 2-(4-cyanophenyl)-5-[2-(trans-4-ethylcyclohexyl)-ethyl]-pyrimidine,
2-(4-cyanophenyl)-5-[2-(trans-4-propylcyclohexyl)-ethyl]-pyrimidine,
2-(4-cyanophenyl)-5-[2-(trans-4-butylcyclohexyl)-ethyl]-pyrimidine,
2-(4-cyanophenyl)-5-[2-(trans-4-pentylcyclohexyl)-ethyl]-pyrimidine, and
2-(4-cyanophenyl)-5-[2-(trans-4-heptylcyclohexyl)-ethyl]-pyrimidine,
is (sic) excluded,

and it contains (sic) at least one constituent of the formula II



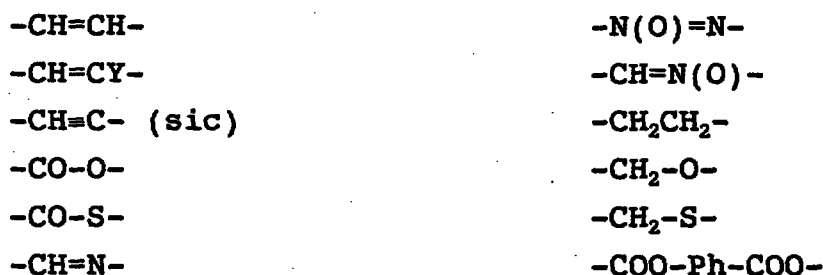


II

wherein

L and E are each a carbo- or heterocyclic ring system from the group formed by 1,4-disubstituted benzene and cyclohexane rings, 4,4'-disubstituted biphenyl, phenylcyclohexane and cyclohexylcyclohexane systems, 2,5-disubstituted pyrimidine and 1,3-dioxane rings, 2,6-disubstituted naphthalene, di- and tetrahydronaphthalene, quinazoline and tetrahydroquinazoline,

G is the formulae



Y is halogen or -CN and

R' and R'' are alkoxy, alkanoyloxy or alkoxycarbonyloxy having up to 8 carbon atoms, or one of these radicals is also CN, NC, NO₂, CF₃, F, Cl or Br, or it contains (sic) at least one other constituent selected from the classes of benzylideneanilines, terphenyls, cyclohexylbiphenyls, cyclohexylcyclohexanes, cyclohexylnaphthalenes, 1,4-bis-cyclohexylbenzenes, 4,4'-bis-cyclohexylbiphenyls, optionally halogenated stilbenes, benzyl phenyl ethers, tolans and substituted cinnamic acids.

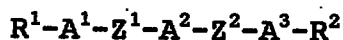
14. Liquid crystal display element, characterized in that it contains a phase according to at least one of Claims 12 and 13.

15. Electro-optical display element according to Claim 14, characterized in that it contains a phase according to at least one of Claims 12 and 13 as the dielectric.



Patent Claims for the Contracting State: FR

1. Compounds of the formula I



wherein

R^1 and R^2 in each case independently of one another are an alkyl group having 1-15 C atoms, it also being possible for one or two non-adjacent CH_2 groups to be replaced by O atoms and/or -CO- groups and/or -O-CO- groups and/or -CO-O- groups, and one of the radicals R^1 and R^2 is also H, F, Cl, or Br

A^1 is a 1,4-cyclohexylene group, it also being possible for one or two non-adjacent CH_2 groups to be replaced by O atoms, a 1,4-bicyclo-(2,2,2)-octylene group or a 1,3-dithiane-2,5-diyl group,

Z^1 and Z^2 in each case independently of one another are $-CH_2CH_2-$, $-OCH_2-$, $-CH_2O-$ or a single bond, and

A^2 and A^3 in each case independently of one another are a 1,4-phenylene group, pyrimidine-2,5-diyl group, 1,4-cyclohexylene group, it also being possible for one or two non-adjacent CH_2 groups to be replaced by O atoms, 1,3-dithiane-2,5-diyl group or a 1,4-bicyclo(2,2,2)-octylene group,

with the provisos that

- (a) at least one of the groups A^2 and A^3 is a pyrimidine-2,5-diyl group,
- (b) at least one of the groups Z^1 and Z^2 is not a single bond if A^2 is pyrimidine-2,5-diyl and R^2 is alkyl or CN,
- (c) 2-(4-cyanophenyl)-5-[2-(trans-4-ethylcyclohexyl)-ethyl]-pyrimidine,
2-(4-cyanophenyl)-5-[2-(trans-4-propylcyclohexyl)-ethyl]-pyrimidine,
2-(4-cyanophenyl)-5-[2-(trans-4-butylcyclohexyl)-ethyl]-pyrimidine,



2-(4-cyanophenyl)-5-[2-(trans-4-pentylcyclohexyl)-ethyl]-pyrimidine, and

2-(4-cyanophenyl)-5-[2-(trans-4-heptylcyclohexyl)-ethyl]-pyrimidine,

is (sic) excluded.

2. Compounds according to Claim 1, wherein R^1 and R^2 in each case independently of one another are a straight-chain alkyl, alkoxy or oxaalkyl group.

3. Compounds according to Claim 1 or 2, wherein A^1 is a trans-1,4-cyclohexylene group.

4. Compounds according to one of Claims 1 to 3 corresponding to the part formulae Ica, Ifi, Ifk, Ifj and Ifl

R^1 -Cy-Pyr-Phe- R^2	Ica
R^1 -Cy- Z^1 -Pyr-Phe- R^2	Ifi
R^1 -Cy- Z^1 -Phe-Pyr- R^2	Ifk
R^1 -Cy-Pyr- Z^2 -Phe- R^2	Iij
R^1 -Cy-Phe- Z^2 -Pyr- R^2	Iil

wherein R^1 and R^2 have the meaning given and

Cy is a 1,4-cyclohexylene group,

Pyr is a pyrimidine-2,5-diyl group,

Phe is a 1,4-phenylene group and

Z^1 and Z^2 are $-\text{CH}_2\text{O}-$, $-\text{OCH}_2-$ or $-\text{CH}_2\text{CH}_2-$.

5. Compounds according to Claim 4 corresponding to the part formulae Ica, Ifi, Ifk, Iij and Iil, wherein R^1 , Z^1 , Z^2 , Cy, Pyr and Phe have the meaning given, and R^2 is F.

6. Compounds according to Claim 4 or 5, wherein Z^1 or Z^2 is $-\text{CH}_2\text{CH}_2-$ or $-\text{CH}_2\text{O}-$.

7. Compounds according to Claim 3 corresponding to the part formulae

Alkyl-Cy-Cy-Pyr-Alkyl

Alkyl-Cy-Cy-Pyr-Alkoxy

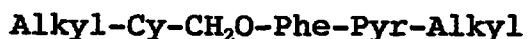
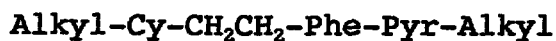
wherein Cy and Pyr have the meaning given in Claim 2 and alkyl is a straight-chain alkyl group having 2 to 10





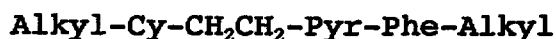
C atoms and alkoxy is a straight-chain alkoxy group having 2 to 12 C atoms.

8. Compounds according to Claim 4 corresponding to the part formulae



wherein Cy, Phe and Pyr have the meaning given in Claim 4 and alkyl in each case is a straight-chain alkyl group having 2 to 10 C atoms.

9. Compounds according to Claim 4 corresponding to the part formulae



wherein Cy, Phe and Pyr have the meaning given in Claim 4 and alkyl in each case is a straight-chain alkyl group having 2 to 10 C atoms.

10. Process for the preparation of compounds of the formula I according to Claim 1, characterized in that a compound which otherwise corresponds to the formula I but contains one or more reducible groups and/or C-C bonds instead of H atoms is treated with a reducing agent, or in that, to prepare esters of the formula I (wherein R^1 and/or R^2 are an alkyl group, in which one or two CH_2 groups are replaced by $-\text{O}-\text{CO}-$ groups and/or $-\text{CO}-\text{O}-$ groups), a corresponding carboxylic acid or one of its reactive derivatives is reacted with a corresponding alcohol or one of its reactive derivatives, or in that, to prepare 1,3-dioxane derivatives or 1,3-dithiane derivatives of the formula I (wherein A^1 is 1,3-dioxane-2,5-diyl or 1,3-dithiane-2,5-diyl), a corresponding aldehyde is reacted with a corresponding diol or dithiol, or in that, to prepare ethers of the formula I (wherein R^1 and/or R^2 are an alkyl group, in which one or two CH_2

groups are replaced by O atoms, and/or Z is an $-OCH_2-$ or $-CH_2O-$ group), a corresponding hydroxy compound is etherified.

11. Use of the compounds of the formula I according to Claim 1 as components of liquid crystal phases.

12. Liquid crystal phase containing at least two liquid crystal components, characterized in that at least one component is a compound of the formula I according to Claim 1.

13. Liquid crystal display element, characterized in that it contains a phase according to Claim 12.

14. Electrooptical display element according to Claim 13, characterized in that it contains a phase according to Claim 12 as the dielectric.



As printed

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Revendications pour les Etats contractants: CH DE GB LI

1. Composés de formule I



dans laquelle

R^1 et R^2 représentent chacun, indépendamment l'un de l'autre, un groupe alkyle en C1—C15 dans lequel un ou deux groupes CH_2 non voisins peuvent être remplacés par des atomes d'oxygène et/ou des groupes $-CO-$ et/ou des groupes $-O-CO-$ et/ou des groupes $-CO-O-$, l'un des symboles R^1 et R^2 pouvant également représenter H, F, Cl, Br ou CN,

A^1 représente un groupe 1,4-cyclohexylène dans lequel un ou deux groupes CH_2 non voisins peuvent être remplacés par des atomes d'oxygène, un groupe 1,4-bicyclo(2,2,2)octylène ou un groupe 1,3-dithiane-2,5-diyle,

Z^1 et Z^2 représentent chacun indépendamment l'un de l'autre, $-CH_2CH_2-$, $-OCH_2-$, $-CH_2O-$ ou une liaison simple, et

A^2 et A^3 représentent chacun, indépendamment l'un de l'autre, un groupe 1,4-phénylène, un groupe pyrimidine-2,5-diyle, un groupe 1,4-cyclohexylène dans lequel un ou deux groupes CH_2 non voisins peuvent être remplacés par des atomes d'oxygène, un groupe 1,3-dithiane-2,5-diyle ou un groupe 1,4-bicyclo(2,2,2)octylène, avec les réserves suivantes:

(a) au moins un des symboles A^2 et A^3 représente un groupe pyrimidine-2,5-diyle,

(b) au moins un des symboles Z^1 et Z^2 ne peut représenter une liaison simple lorsque A^2 représente un groupe pyrimidine-2,5-diyle et R^2 un groupe alkyle ou CN,

(c) sont exclues:

la 2-(4-cyanophényl)-5-[2-(trans-4-éthylcyclohexyl)-éthyl]-pyrimidine,

la 2-(4-cyanophényl)-5-[2-(trans-4-propylcyclohexyl)-éthyl]-pyrimidine,

la 2-(4-cyanophényl)-5-[2-(trans-4-butylcyclohexyl)-éthyl]-pyrimidine,

la 2-(4-cyanophényl)-5-[2-(trans-4-pentylcyclohexyl)-éthyl]-pyrimidine,

la 2-(4-cyanophényl)-5-[2-(trans-4-heptylcyclohexyl)-éthyl]-pyrimidine, et

(d) sont exclues les 5-alkyl-2-[4'-(trans-4'-alkylcyclohexyl)-phényl]-pyrimidines.

2. Composés selon la revendication 1, dans lesquels R^1 et R^2 représentent chacun, indépendamment l'un de l'autre, un groupe alkyle, alcoxy ou oxa-alkyle à chaîne droite.

3. Composés selon la revendication 1 ou 2, dans lesquels A^1 représente un groupe trans-1,4-cyclohexylène.

4. Composés selon l'une des revendications 1 à 3, répondant aux formules partielles lca, lfi, lfk, lij et lil.

$R^1-Cy-Pyr-Phe-R^2$	lca
$R^1-Cy-Z^1-Pyr-Phe-R^2$	lfi
$R^1-Cy-Z^1-Phe-Pyr-R^2$	lfk
$R^1-Cy-Pyr-Z^2-Phe-R^2$	lij
$R^1-Cy-Phe-Z^2-Pyr-R^2$	lil,

dans lesquelles R^1 et R^2 ont les significations indiquées ci-dessus, et

Cy représente un groupe 1,4-cyclohexylène,

Pyr représente un groupe pyrimidine-2,5-diyle,

Phe représente un groupe 1,4-phénylène, et

Z^1 et Z^2 représentent $-CH_2O-$, $-OCH_2-$, ou $-CH_2CH_2-$.

5. Composés selon la revendication 4, répondant aux formules partielles lca, lfi, lfk, lij et lil dans lesquelles R^1 , Z^1 , Z^2 , Cy, Pyr et Phe ont les significations indiquées ci-dessus, et R^2 représente F.

6. Composés selon la revendication 4 ou 5, dans lesquels Z^1 et/ou Z^2 représentent $-CH_2CH_2-$ ou $-CH_2O-$.

7. Composé selon la revendication 3, répondant aux formules partielles

Alkyl-Cy-Cy-Pyr-Alkyl

Alkyl-Cy-Cy-Pyr-Alkoxy

dans lesquelles Cy et Pyr ont les significations indiquées dans la revendication 2 et "Alkyl" représente un groupe alkyle à chaîne droite en C2—C10 et "Alkoxy" un groupe alcoxy à chaîne droite en C2—C12.

8. Composés selon la revendication 4, répondant aux formules partielles

Alkyl-Cy- CH_2CH_2 -Phe-Pyr-Alkyl

Alkyl-Cy- CH_2O -Phe-Pyr-Alkyl

dans lesquelles Cy, Phe et Pyr ont les significations indiquées dans la revendication 4 et chacun des symboles "Alkyl" représente un groupe alkyle à chaîne droite en C2—C10.

9. Composés selon la revendication 4, répondant aux formules partielles

Alkyl-Cy- CH_2CH_2 -Pyr-Phe-Alkyl

Alkyl-Cy- CH_2CH_2 -Pyr-Phe-F

Alkyl-Cy- CH_2CH_2 -Pyr-Phe-CN





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dans lesquelles Cy, Phe et Pyr ont les significations indiquées dans la revendication 4, et chacun des symboles "Alkyl" représente un groupe alkyle à chaîne droite en C2—C10.

10. Procédé de préparation des composés de formule I de la revendication 1, caractérisé en ce que l'on traite par un agent réducteur un composé répondant par ailleurs à la formule I mais contenant, à la place d'atomes d'hydrogène, un ou plusieurs groupes réductibles et/ou une ou plusieurs liaisons C—C,

ou bien en ce que, pour préparer les esters de formule I (dans laquelle R¹ et/ou R² représentent des groupes alkyle dans lesquels un ou deux groupes CH₂ sont remplacés par des groupes —O—CO— et/ou —CO—O—), on fait réagir un acide carboxylique correspondant ou l'un de ses dérivés réactifs avec un alcool correspondant ou l'un de ses dérivés réactifs,

ou bien en ce que, pour préparer les dérivés du 1,3-dioxanne ou du 1,3-dithiane de formule I (dans laquelle A¹ représente respectivement un groupe 1,3-dioxanne-2,5-diyle ou 1,3-dithiane-2,5-diyle) on fait réagir un aldéhyde correspondant avec un diol ou dithiol correspondant respectivement,

ou bien en ce que, pour préparer les éthers de formule I (dans laquelle R¹ et/ou R² représentent des groupes alkyle dans lesquels un ou deux groupes CH₂ sont remplacés par des atomes d'oxygène, et/ou Z représente un groupe —OCH₂— ou —CH₂O—), on éthérifie un dérivé hydroxylé correspondant,

11. Utilisation des composés de formule I de la revendication 1 en tant que composants de phases à cristaux liquides.

12. Phase à cristaux liquides contenant au moins deux composants à cristaux liquides, caractérisée en ce que l'un au moins des composants est un composé de formule I de la revendication 1.

13. Phase à cristaux liquides à au moins deux composants à cristaux liquides, caractérisée en ce que l'un au moins des composants est un composé de formule I



I

dans laquelle R¹, R², A¹, A², A³, Z¹ et Z² ont les significations indiquées dans la revendication 1, avec les réserves suivantes:

(a) l'un au moins des symboles A² et A³ représente un groupe pyrimidine-2,5-diyle, et

(b) l'un au moins des symboles Z¹ et Z² ne peut représenter un liaison simple lorsque A² représente un groupe pyrimidine-2,5-diyle et R² un groupe alkyle ou CN,

(c) sont exclues:

la 2-(4-cyanophényl)-5-[2-(trans-4-propylcyclohexyl)éthyl]-pyrimidine,

la 2-(4-cyanophényl)-5-[2-(trans-4-propylcyclohexyl)éthyl]-pyrimidine,

la 2-(4-cyanophényl)-5-[2-(trans-4-butylcyclohexyl)éthyl]-pyrimidine,

la 2-(4-cyanophényl)-5-[2-(trans-4-pentylcyclohexyl)éthyl]-pyrimidine,

la 2-(4-cyanophényl)-5-[2-(trans-4-heptylcyclohexyl)éthyl]-pyrimidine,

et la phase contient au moins un constituant de formula II

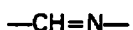
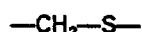
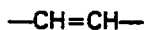


II

dans laquelle

L et E représentent chacun un système carbocyclique ou hétérocyclique pris dans le groupe formé par les cycles benzène et cyclohexane 1,4-disubstitués, les systèmes biphenyle, phénylcyclohexane et cyclohexylcyclohexane 4,4'-disubstitués, les cycles pyrimidine et 1,3-dioxanne 2,5-disubstitués, le naphtalène 2,6-disubstitué, le diet le tétrahydronaphtalène, la quinazoline et la tétrahydroquinazoline,

G représente



Y représente un halogène ou un groupe —CN, et

R' et R'' représentent des groupes alcoxy, alcanoyloxy ou alcoxycarbonyloxy contenant jusqu'à 8 atomes de carbone, l'un des ces symboles pouvant également représenter CN, NC, NO₂, CF₃, F, Cl ou Br, ou bien elle contient au moins un autre constituant choisi dans les classes des benzyldèneanilines, des terphényles, des cyclohexylbiphenyles, des cyclohexylcyclohexanes, des cyclohexylnaphtalènes, des 1,4-bis-cyclohexylbenzènes, des 4,4'-bis-cyclohexylbiphenyles, des stilbènes éventuellement halogénés, des éthers benzylphényliques, des tolanes et des acides cinnamiques substitués.

14. Élément d'affichage à cristaux liquides, caractérisé en ce qu'il contient une phase selon au moins une des revendications 12 et 13.

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15. Elément d'affichage électro-optique selon la revendication 14, caractérisé en ce qu'il contient en tant que diélectrique une phase selon au moins une des revendications 12 et 13.

Revendications pour l'Etat contractant: FR

1. Composé de formule I



dans laquelle

R^1 et R^2 représentent chacun, indépendamment l'un de l'autre, un groupe alkyle en C1—C15 dans lequel un ou deux groupes CH_2 non voisins peuvent être remplacés par des atomes d'oxygène et/ou des groupes $-CO-$ et/ou des groupes $-O-CO-$ et/ou des groupes $-CO-O-$, l'un des symboles R^1 et R^2 pouvant également représenter H, F, Cl ou Br,

A^1 représente un groupe 1,4-cyclohexylène dans lequel un ou deux groupes CH_2 non voisins peuvent être remplacés par des atomes d'oxygène, un groupe 1,4-bicyclo(2,2,2)octylène ou un groupe 1,3-dithiane-2,5-diyle,

Z^1 et Z^2 représentent chacun indépendamment l'un de l'autre, un groupe $-CH_2CH_2-$, $-OCH_2-$, $-CH_2O-$ ou une liaison simple, et

A^2 et A^3 représentent chacun, indépendamment l'un de l'autre, un groupe 1,4-phénylène, un groupe pyrimidine-2,5-diyle, un groupe 1,4-cyclohexylène dans lequel un ou deux groupes CH_2 non voisins peuvent être remplacés par des atomes d'oxygène, un groupe 1,3-dithiane-2,5-diyle ou un groupe 1,4-bicyclo(2,2,2)octylène, avec les réserves suivantes:

(a) au moins un des symboles A^2 et A^3 représente un groupe pyrimidine-2,5-diyle,

(b) au moins un des symboles Z^1 et Z^2 ne peut représenter une liaison simple lorsque A^2 représente un groupe pyrimidine-2,5-diyle et R^2 un groupe alkyle ou CN,

(c) sont exclues:

la 2-(4-cyanophényl)-5-[2-(trans-4-éthylcyclohexyl)-éthyl]-pyrimidine,

la 2-(4-cyanophényl)-5-[2-(trans-4-propylcyclohexyl)-éthyl]-pyrimidine,

la 2-(4-cyanophényl)-5-[2-(trans-4-butylcyclohexyl)-éthyl]-pyrimidine,

la 2-(4-cyanophényl)-5-[2-(trans-4-pentylcyclohexyl)-éthyl]-pyrimidine,

la 2-(4-cyanophényl)-5-[2-(trans-4-heptylcyclohexyl)-éthyl]-pyrimidine.

2. Composés selon la revendication 1, dans lesquels R^1 et R^2 représentent chacun, indépendamment l'un de l'autre, un groupe alkyle, alcoxy ou oxa-alkyle à chaîne droite.

3. Composés selon la revendication 1 ou 2, dans lesquels A^1 représente un group trans-1,4-cyclohexylène.

4. Composés selon l'une des revendications 1 à 3, répondant aux formules partielles lca, lfi, lfk, lfj et lfl.

$R^1-Cy-Pyr-Phe-R^2$	lca
$R^1-Cy-Z^1-Pyr-Phe-R^2$	lfi
$R^1-Cy-Z^1-Phe-Pyr-R^2$	lfk
$R^1-Cy-Pyr-Z^2-Phe-R^2$	lij
$R^1-Cy-Phe-Z^2-Pyr-R^2$	lil,

dans lesquelles R^1 et R^2 ont les significations indiquées ci-dessus, et

Cy représente un groupe 1,4-cyclohexylène,

Pyr représente un groupe pyrimidine-2,5-diyle,

Phe représente un groupe 1,4-phénylène, et

Z^1 et Z^2 représentent $-CH_2O-$, $-OCH_2-$, ou $-CH_2CH_2-$.

5. Composés selon la revendication 4, répondant aux formules partielles lca, lfi, lfk, lij et lil dans lesquelles R^1 , Z^1 , Z^2 , Cy, Pyr et Phe ont les significations indiquées ci-dessus, et

R^2 représente F.

6. Composés selon la revendication 4 ou 5, dans lesquels Z^1 et/ou Z^2 représentent $-CH_2CH_2-$ ou $-CH_2O-$.

7. Composé selon la revendication 3, répondant aux formules partielles

Alkyl-Cy-Cy-Pyr-Alkyl

Alkyl-Cy-Cy-Pyr-Alkoxy

dans lesquelles Cy et Pyr ont les significations indiquées dans la revendication 2 et "Alkyl" représente un group alkyle à chaîne droite en C2—C10 et "Alkoxy" un groupe alcoxy à chaîne droite en C2—C12.

8. Composés selon la revendication 4, répondant aux formules partielles

Alkyl-Cy- CH_2CH_2 -Phe-Pyr-Alkyl

Alkyl-Cy- CH_2O -Phe-Pyr-Alkyl

dans lesquelles Cy, Phe et Pyr ont les significations indiquées dans la revendication 4 et chacun des symboles "Alkyl" représente un groupe alkyle à chaîne droite en C2—C10.

9. Composés selon la revendication 4, répondant aux formules partielles



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Alkyl-Cy-CH₂CH₂-Pyr-Phe-Alkyl

Alkyl-Cy-CH₂CH₂-Pyr-Phe-F

Alkyl-Cy-CH₂CH₂-Pyr-Phe-CN

dans lesquelles Cy, Phe et Pyr ont les significations indiquées dans la revendication 4, et chacun des symboles "Alkyl" représente un groupe alkyle à chaîne droite en C₂-C₁₀.

10. Procédé de préparation des composés de formule I de la revendication 1, caractérisé en ce que l'on traite par un agent réducteur un composé répondant par ailleurs à la formule I mais contenant, à la place d'atomes d'hydrogène, un ou plusieurs groupes réductibles et/ou une ou plusieurs liaisons C=C,

ou bien en ce que, pour préparer les esters de formule I (dans laquelle R¹ et/ou R² représentent des groupes alkyle dans lesquels un ou deux groupes CH₂ sont remplacés par des groupes —O—CO— et/ou —CO—O—), on fait réagir un acide carboxylique correspondant ou l'un de ses dérivés réactifs avec un alcool correspondant ou l'un de ses dérivés réactifs,

ou bien en ce que, pour préparer les dérivés du 1,3-dioxanne ou du 1,3-dithiane de formule I (dans laquelle A¹ représente respectivement un groupe 1,3-dioxanne-2,5-diyle ou 1,3-dithiane-2,5-diyle) on fait réagir un aldéhyde correspondant avec un diol ou dithiol correspondant respectivement,

ou bien en ce que, pour préparer les éthers de formule I (dans laquelle R¹ et/ou R² représentent des groupes alkyle dans lesquels un ou deux groupes CH₂ sont remplacés par des atomes d'oxygène, et/ou Z représente un groupe —OCH₂— ou —CH₂O—), on éthérifie un composé hydroxylé correspondant,

11. Utilisation des composés de formule I de la revendication 1 en tant que composants de phases à cristaux liquides.

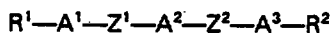
12. Phase à cristaux liquides contenant au moins deux composants à cristaux liquides, caractérisée en ce que l'un au moins des composants est un composé de formule I de la revendication 1.

13. Élément d'affichage à cristaux liquides, caractérisé en ce qu'il contient une phase selon la revendication 12.

14. Élément d'affichage électro-optique selon la revendication 13, caractérisé en ce qu'il contient en tant que diélectrique une phase selon la revendication 12.

Claims for the Contracting States: CH DE GB LI

1. Compounds of the formula I



wherein

R¹ and R² in each case independently of one another are an alkyl group having 1-15 C atoms, it also being possible for one or two non-adjacent CH₂ groups to be replaced by O atoms and/or —CO— groups and/or —O—CO— groups and/or —CO—O— groups, and one of the radicals R¹ and R² is also H, F, Cl, Br or CN,

A¹ is a 1,4-cyclohexylene group, it also being possible for one or two non-adjacent CH₂ groups to be replaced by O atoms, a 1,4-bicyclo-(2,2,2)-octylene group or a 1,3-dithiane-2,5-diyl group,

Z¹ and Z² in each case independently of one another are —CH₂CH₂—, —OCH₂—, —CH₂O— or a single bond, and

A² and A³ in each case independently of one another are a 1,4-phenylene group, pyrimidine-2,5-diyl group, 1,4-cyclohexylene group, it also being possible for one or two non-adjacent CH₂ groups to be replaced by O atoms, 1,3-dithiane-2,5-diyl group or a 1,4-bicyclo(2,2,2)-octylene group, with the provisos that

(a) at least one of the groups A² and A³ is a pyrimidine-2,5-diyl group,

(b) at least one of the groups Z¹ and Z² is not a single bond if A² is pyrimidine-2,5-diyl and R² is alkyl or CN,

(c) 2-(4-cyanophenyl)-5-[2-(trans-4-ethylcyclohexyl)-ethyl]-pyrimidine,
2-(4-cyanophenyl)-5-[2-(trans-4-propylcyclohexyl)-ethyl]-pyrimidine,
2-(4-cyanophenyl)-5-[2-(trans-4-butylcyclohexyl)-ethyl]-pyrimidine,
2-(4-cyanophenyl)-5-[2-(trans-4-pentylcyclohexyl)-ethyl]-pyrimidine, and
2-(4-cyanophenyl)-5-[2-(trans-4-heptylcyclohexyl)-ethyl]-pyrimidine,
is (sic) excluded, and

(d) 5-alkyl-2-(4'-(trans-4'-alkylcyclohexyl)phenyl)pyrimidines are excluded.

2. Compounds according to Claim 1, wherein R¹ and R² in each case independently of one another are a straight-chain alkyl, alkoxy or oxaalkyl group.

3. Compounds according to Claim 1 or 2, wherein

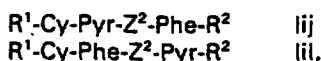
A¹ is a trans-1,4-cyclohexylene group.

4. Compounds according to one of Claims 1 to 3 corresponding to the part formulae lca, lfi, lfk, lfj and lfl

R ¹ -Cy-Pyr-Phe-R ²	lca
R ¹ -Cy-Z ¹ -Pyr-Phe-R ²	lfi
R ¹ -Cy-Z ¹ -Phe-Pyr-R ²	lfk



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wherein R^1 and R^2 have the meaning given and

Cy is a 1,4-cyclohexylene group,
Pyr is a pyrimidine-2,5-diyl group,
Phe is a 1,4-phenylene group and
 Z^1 and Z^2 are $-\text{CH}_2\text{O}-$, $-\text{OCH}_2-$ or $-\text{CH}_2\text{CH}_2-$.

5. Compounds according to Claim 4 corresponding to the part formulae lca, lfi, lfk, lij and lil, wherein R^1 , Z^1 , Z^2 , Cy, Pyr and Phe have the meaning given, and R^2 is F.

6. Compounds according to Claim 4 or 5, wherein Z^1 or Z^2 is $-\text{CH}_2\text{CH}_2-$ or $-\text{CH}_2\text{O}-$.

7. Compounds according to Claim 3 corresponding to the part formulae

Alkyl-Cy-Cy-Pyr-Alkyl
Alkyl-Cy-Cy-Pyr-Alkoxy

wherein Cy and Pyr have the meaning given in Claim 2 and alkyl is a straight-chain alkyl group having 2 to 10 C atoms and alkoxy is a straight-chain alkoxy group having 2 to 12 C atoms.

8. Compounds according to Claim 4 corresponding to the part formulae

Alkyl-Cy- CH_2CH_2 -Phe-Pyr-Alkyl
Alkyl-Cy- CH_2O -Phe-Pyr-Alkyl

wherein Cy, Phe and Pyr have the meaning given in Claim 4 and alkyl in each case is a straight-chain alkyl group having 2 to 10 C atoms.

9. Compounds according to Claim 4 corresponding to the part formulae

Alkyl-Cy- CH_2CH_2 -Pyr-Phe-Alkyl
Alkyl-Cy- CH_2CH_2 -Pyr-Phe-F
Alkyl-Cy- CH_2CH_2 -Pyr-Phe-CN

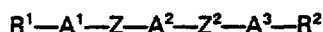
wherein Cy, Phe and Pyr have the meaning given in Claim 4 and alkyl in each case is a straight-chain alkyl group having 2 to 10 C atoms.

10. Process for the preparation of compounds of the formula I according to Claim 1, characterized in that a compound which otherwise corresponds to the formula I but contains one or more reducible groups and/or C—C bonds instead of H atoms is treated with a reducing agent, or in that, to prepare esters of the formula I (wherein R^1 and/or R^2 are an alkyl group, in which one or two CH_2 groups are replaced by $-\text{O}-\text{CO}-$ groups and/or $-\text{CO}-\text{O}-$ groups), a corresponding carboxylic acid or one of its reactive derivatives is reacted with a corresponding alcohol or one of its reactive derivatives, or in that, to prepare 1,3-dioxane derivatives or 1,3-dithiane derivatives of the formula I (wherein A^1 is 1,3-dioxane-2,5-diyl or 1,3-dithiane-2,5-diyl), a corresponding aldehyde is reacted with a corresponding diol or dithiol, or in that, to prepare ethers of the formula I (wherein R^1 and/or R^2 are an alkyl group, in which one or two CH_2 groups are replaced by O atoms, and/or Z is an $-\text{OCH}_2-$ or $-\text{CH}_2\text{O}-$ group), a corresponding hydroxy compound is etherified.

11. Use of the compounds of the formula I according to Claim 1 as components of liquid crystal phases.

12. Liquid crystal phase containing at least two liquid crystal components characterized in that at least one component is a compound of the formula I according to Claim 1.

13. Liquid crystal phase containing at least two liquid crystal components, characterized in that at least one component is a compound of the formula I



wherein R^1 , R^2 , A^2 , A^3 , Z^1 and Z^2 have the meaning given in Claim 1, with the provisos that

(a) at least one of the groups A^2 and A^3 is a pyrimidine-2,5-diyl group, and

(b) at least one of the groups Z^1 and Z^2 is not a single bond if A^2 is pyrimidine-2,5-diyl and R^2 is alkyl or CN, and

(c) 2-(4-cyanophenyl)-5-[2-(trans-4-ethylcyclohexyl)-ethyl]pyrimidine,
2-(4-cyanophenyl)-5-[2-(trans-4-propylcyclohexyl)-ethyl]pyrimidine,
2-(4-cyanophenyl)-5-[2-(trans-4-butylcyclohexyl)-ethyl]pyrimidine, -
2-(4-cyanophenyl)-5-[2-(trans-4-pentylcyclohexyl)-ethyl]pyrimidine and
2-(4-cyanophenyl)-5-[2-(trans-4-heptylcyclohexyl)-ethyl]pyrimidine, is (sic) excluded, and it contains

(sic) at least one constituent of the formula II



II

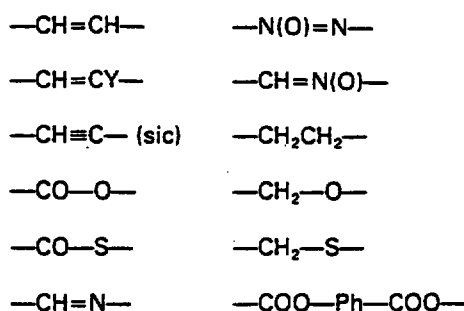
wherein

L and E are each a carbo- or heterocyclic ring system from the group formed by 1,4-disubstituted benzene and cyclohexane rings, 4,4'-disubstituted biphenyl, phenylcyclohexane and cyclohexylcyclohexane systems, 2,5-disubstituted pyrimidine and 1,3-dioxane rings, 2,6-disubstituted naphthalene, di- and tetrahydronaphthalene, quinazoline and tetrahydroquinazoline,



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G is the formulae



Y is halogen or —CN and

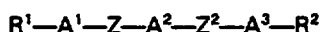
R' and R'' are alkoxy, alkanoyloxy or alkoxy-carbonyloxy having up to 8 carbon atoms, or one of these radicals is also CN , NC , NO_2 , CF_3 , F , Cl or Br , or it contains (sic) at least one other constituent selected from the classes of benzylideneanilines, terphenyls, cyclohexylbiphenyls, cyclohexylcyclohexanes, cyclohexylnaphthalenes, 1,4-bis-cyclohexylbenzenes, 4,4'-bis-cyclohexylbiphenyls, optionally halogenated stilbenes, benzyl phenyl ethers, tolans and substituted cinnamic acids.

14. Liquid crystal display element, characterized in that it contains a phase according to at least one of Claims 12 and 13.

15. Electro-optical display element according to Claim 14, characterized in that it contains a phase according to at least one of claims 12 and 13 as the dielectric.

Claims for the Contracting State: FR

1. Compounds of the formula I



wherein

R^1 and R^2 in each case independently of one another are an alkyl group having 1—15 C atoms, it also being possible for one or two non-adjacent CH_2 groups to be replaced by O atoms and/or —CO— groups and/or —O—CO— groups and/or —CO—O— groups, and one of the radicals R^1 and R^2 is also H, F, Cl, or Br,

A^1 is a 1,4-cyclohexylene group, it also being possible for one or two non-adjacent CH_2 groups to be replaced by O atoms, a 1,4-bicyclo-(2,2,2)-octylene group or a 1,3-dithiane-2,5-diyl group,

Z^1 and Z^2 in each case independently of one another are $\text{—CH}_2\text{CH}_2\text{—}$, $\text{—OCH}_2\text{—}$, $\text{—CH}_2\text{O—}$ or a single bond, and

A^2 and A^3 in each case independently of one another are a 1,4-phenylene group, pyrimidine-2,5-diyl group, 1,4-cyclohexylene group, it also being possible for one or two non-adjacent CH_2 groups to be replaced by O atoms, 1,3-dithiane-2,5-diyl group or a 1,4-bicyclo(2,2,2)-octylene group, with the provisos that

(a) at least one of the groups A^2 and A^3 is a pyrimidine-2,5-diyl group,

(b) at least one of the groups Z^1 and Z^2 is not a single bond if A^2 is pyrimidine-2,5-diyl and R^2 is alkyl or CN,

(c) 2-(4-cyanophenyl)-5-[2-(trans-4-ethylcyclohexyl)-ethyl]-pyrimidine,

2-(4-cyanophenyl)-5-[2-(trans-4-propylcyclohexyl)-ethyl]-pyrimidine,

2-(4-cyanophenyl)-5-[2-(trans-4-butylcyclohexyl)-ethyl]-pyrimidine,

2-(4-cyanophenyl)-5-[2-(trans-4-pentylcyclohexyl)-ethyl]-pyrimidine, and

2-(4-cyanophenyl)-5-[2-(trans-4-heptylcyclohexyl)-ethyl]-pyrimidine,

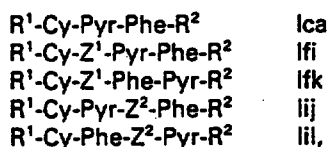
is (sic) excluded.

2. Compounds according to Claim 1, wherein R^1 and R^2 in each case independently of one another are a straight-chain alkyl, alkoxy or oxaalkyl group.

3. Compounds according to Claim 1 or 2, wherein

A^1 is a trans-1,4-cyclohexylene group.

4. Compounds according to one of Claims 1 to 3 corresponding to the part formulae Ica, Ifi, Ifk, Ifj and Ifl



wherein R^1 and R^2 have the meaning given and

Cy is a 1,4-cyclohexylene group,

Pyr is a pyrimidine-2,5-diyl group,



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Phe is a 1,4-phenylene group and

Z¹ and Z² are —CH₂O—, —OCH₂— or —CH₂CH₂—.

5. Compounds according to Claim 4 corresponding to the part formulae lca, lfi, lfk, lij and lil, wherein R¹, Z¹, Z², Cy, Pyr and Phe have the meaning given, and R² is F.

6. Compounds according to Claim 4 or 5, wherein Z¹ or Z² is —CH₂CH₂— or —CH₂O—.

7. Compounds according to Claim 3 corresponding to the part formulae

Alkyl-Cy-Cy-Pyr-Alkyl

Alkyl-Cy-Cy-Pyr-Alkoxy

wherein Cy and Pyr have the meaning given in Claim 2 and alkyl is a straight-chain alkyl group having 2 to 10 C atoms and alkoxy is a straight-chain alkoxy group having 2 to 12 C atoms.

8. Compounds according to Claim 4 corresponding to the part formulae

Alkyl-Cy-CH₂CH₂-Phe-Pyr-Alkyl

Alkyl-Cy-CH₂O-Phe-Pyr-Alkyl

wherein Cy, Phe and Pyr have the meaning given in Claim 4 and alkyl in each case is a straight-chain alkyl group having 2 to 10 C atoms.

9. Compound according to Claim 4 corresponding to the part formulae

Alkyl-Cy-CH₂CH₂-Pyr-Phe-Alkyl

Alkyl-Cy-CH₂CH₂-Pyr-Phe-F

Alkyl-Cy-CH₂CH₂-Pyr-Phe-CN

wherein Cy, Phe and Pyr have the meaning given in Claim 4 and alkyl in each case is a straight-chain alkyl group having 2 to 10 C atoms.

10. Process for the preparation of compounds of the formula I according to Claim 1, characterized in that a compound which otherwise corresponds to the formula I but contains one or more reducible groups and/or C—C bonds instead of H atoms is treated with a reducing agent, or in that, to prepare esters of the formula I (wherein R¹ and/or R² are an alkyl group, in which one or two CH₂ groups are replaced by —O—CO— groups and/or —CO—O— groups), a corresponding carboxylic acid or one of its reactive derivatives is reacted with a corresponding alcohol or one of its reactive derivatives, or in that, to prepare 1,3-dioxane derivatives or 1,3-dithiane derivatives of the formula I (wherein A¹ is 1,3-dioxane-2,5-diyl or 1,3-dithiane-2,5-diyl), a corresponding aldehyde is reacted with a corresponding diol or dithiol, or in that, to prepare ethers of the formula I (wherein R¹ and/or R² are an alkyl group, in which one or two CH₂ groups are replaced by O atoms, and/or Z is an —OCH₂— or —CH₂O— group), a corresponding hydroxy compound is etherified.

11. Use of the compounds of the formula I according to Claim 1 as components of liquid crystal phases.

12. Liquid crystal phase containing at least two liquid crystal components, characterized in that at least one component is a compound of the formula I according to Claim 1.

13. Liquid crystal display element, characterized in that it contains a phase according to Claim 12.

14. Electrooptical display element according to Claim 13, characterized in that it contains a phase according to Claim 12 as the dielectric.



* C L N S *