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D a r m s t a d t

Cyclohexane derivatives

5 The invention relates to cyclohexane derivatives, processes for their preparation and their use as constituents of liquid crystal materials, especially of dielectrics for liquid crystal display elements.

 For liquid crystal display elements, the properties
10 of nematic or nematic-cholesteric liquid crystal materials are utilised to effect a significant change in their optical properties, such as light transmission, light scattering, double refraction, reflectance or colour under the influence of electrical fields. The action of such display ele-
15 ments is based, for example, on the phenomenon of dynamic scattering, the deformation of set up(~~st~~)phases or the Schadt-Helfrich effect in the twisted cell.

 For industrial application of these effects in liquid crystal display elements, liquid crystal materials
20 are required which have to meet a large number of requirements. Particularly important requirements are the chemical stability towards moisture, air and physical influences, such as heat, radiation in the infrared, visible and ultraviolet range and electrical continuous and alter-
25 nating fields. Furthermore, a liquid crystal mesophase in the temperature range from at least 0°C to + 60°C and preferably from - 20°C to + 80°C and a viscosity at room

temperature of not more than 70 cP are demanded for liquid crystal materials which can be used industrially.

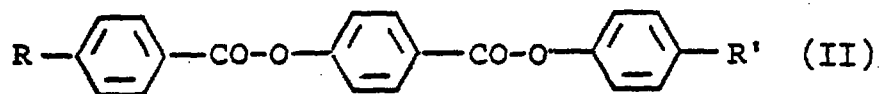
Finally, these materials must not have any characteristic absorption in the range of visible light, that is to say

5 they must be colourless.

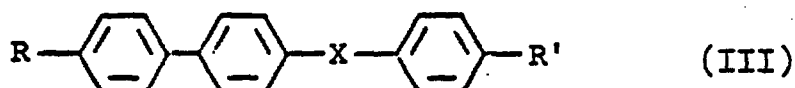
A number of liquid crystal compounds which meet the stability requirements demanded of dielectrics for electronic components and which are also colourless are already known. These include, in particular, the p,p'-disubstituted phenyl benzoates described in German Offenlegungsschrift 2,139,628 and the p,p'-disubstituted biphenyl derivatives described in German Offenlegungsschrift 2,356,085. In both of the said categories of compounds and also in other known series of compounds having a liquid crystal mesophase, 15 there are no individual compounds which form a liquid crystal nematic mesophase in the required temperature range from 0°C to 60°C. Therefore, as a rule, mixtures of two or more compounds are prepared in order to obtain substances which can be used as liquid crystal dielectrics. For this 20 purpose, usually at least one compound having a low melting point and clear point is mixed with another compound having a significantly higher melting point and clear point. This usually gives a mixture which has a melting point at a temperature lower than or about the same as the melting 25 point of the component having a lower melting point, whilst the clear point is between the clear points of the components.

Components having higher melting points and clear points which have been used hitherto are, for example, 4,4"-disubstituted phenyl p-benzoyloxybenzoates of the general

formula (II)

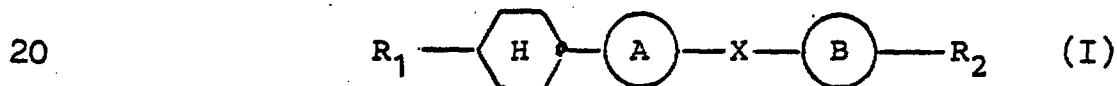


or the biphenyl ester derivatives of the general formula (III)



5 in which formulae R and R' are alkyl or alkoxy groups and X is a carbonyloxy group. The compounds of the general formula (II) have not, however, found a wide field of application because they impart a high viscosity to the liquid crystal dielectrics containing them; as a result, 10 the switching times of the liquid crystal display elements prepared with these compounds are prolonged in an undesirable manner. It is true that this effect is not observed when the biphenyl esters of the general formula (III) are used, but these compounds, in particular at low temperatures, 15 are not readily soluble in the most important liquid crystal base materials, as is desirable if the clear point is to be raised.

It has now been found that the cyclohexane derivatives of the general formula (I)



in which the rings A and B are identical or different and are each a 1,4-disubstituted phenyl or cyclohexyl ring and X is -CO-O- or -O-CO-, R₁ is alkyl with 1 - 8 carbon atoms

and R_2 is alkyl with 1 - 8 carbon atoms, and if the ring B is a phenyl ring R_2 is also alkoxy or alkanoyloxy with up to 8 carbon atoms or -CN, are outstandingly suitable as mixing components for liquid crystal dielectrics.

5 The cyclohexane derivatives of the general formula (I) have melting points and clear points in temperature ranges similar to those of the analogous biphenyl esters but in some liquid crystal base materials, such as, for example, the phenylcyclohexane derivatives according to German Patent
10 Application P 26 36 684, are considerably more readily soluble than the biphenyl esters. As a result of this, they make it possible to prepare dielectrics for liquid crystal display elements which consist of a smaller number of components than dielectrics with comparable properties
15 which have been used hitherto.

It has furthermore been found that in dielectrics for liquid crystal display elements which contain at least one cyclohexane derivative of the general formula (I) the temperature dependence of the threshold voltage is particu-
20 larly low. This characteristic is essential for liquid crystal display elements with a high information packing density, especially for those which operate in multiplex mode.

The invention thus relates to the cyclohexane
25 derivatives of the general formula (I) and to processes for their preparation.

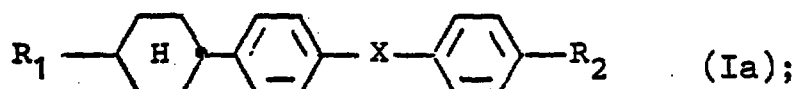
The invention further relates to the use of the cyclohexane derivatives of the general formula (I) in mixtures with other liquid crystal substances as dielectrics in

liquid crystal display elements.

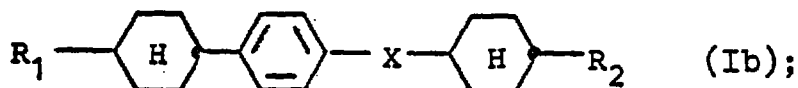
The invention also relates to dielectrics for liquid crystal display elements which contain at least two liquid crystal components, at least one of which is a cyclohexane derivative of the general formula (I).

Preferred groups of cyclohexane derivatives of the general formula (I) are those of the general formulae (Ia) to Id) (sic) that is to say:

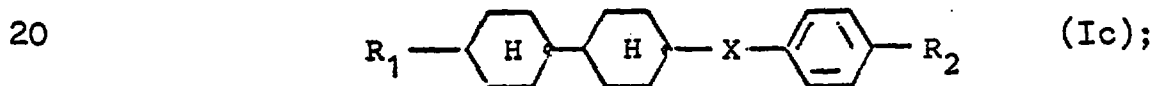
phenyl 4-(4-alkylcyclohexyl)-benzoates and para-substituted 4-(4-alkylcyclohexyl)-phenyl benzoates of the general formula (Ia)



4-alkylcyclohexyl 4-(4-alkylcyclohexyl)-benzoates and 4-(4-alkylcyclohexyl)-phenyl 4-alkyl-cyclohexanecarboxylates of the general formula (Ib)



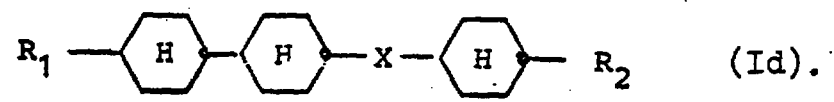
phenyl 4-(4-alkylcyclohexyl)-cyclohexanecarboxylates and para-substituted 4-(4-alkylcyclohexyl)-cyclohex-1-yl benzoates of the general formula (Ic)



and

4-alkylcyclohexyl 4-(4-alkylcyclohexyl)-cyclohexanecarboxylates and 4-(4-alkylcyclohexyl)-cyclohex-1-yl 4-alkylcyclo-

hexanecarboxylates of the general formula (Id)



In these formulae (Ia) to (Id), R_1 , R_2 and X have the meaning indicated in the general formula (I). In all of the cyclohexane derivatives according to the invention, of the general formulae (I) and (Ia) to (Id), the particular substituents in the 1- and 4-positions of the cyclohexane rings are located in the trans-position; in the structural formulae this is symbolised by the black mark on the right-hand side of the cyclohexane rings.

Compounds having a phenyl phenylcyclohexanecarboxylate framework are known from U.S. Application 4,029,595 which are structurally similar to the phenyl cyclohexylbenzoates according to the invention (formula Ia, $X = -CO-O-$) and which are likewise used in liquid crystal display elements. Compared to these previously known compounds, the compounds according to the invention as a rule have markedly wider mesomorphic temperature ranges; when the radical R_2 in the compounds according to the invention is a cyano group, the latter additionally have a markedly greater dielectric anisotropy than the analogously substituted previously known compounds according to U.S. Application 4,029,595.

The cyclohexane derivatives, according to the invention, of the general formula (I) in which X is $-CO-O-$ are prepared from particularly readily accessible starting materials and are therefore preferred.

The substituent R_1 in the compounds of the general

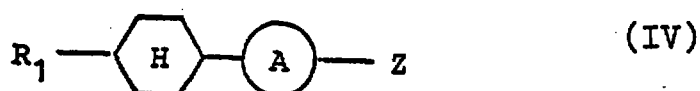
formula (I) can be straight-chain or branched. If R_1 is straight-chain, that is to say is methyl, ethyl, n-propyl, n-butyl, n-pentyl, n-hexyl, n-heptyl or n-octyl, the compounds of the general formula (I) which are characterised by this feature as a rule have particularly high clear points. The compounds of the general formula (I) in which R_1 is an alkyl radical with 1 - 7 and preferably with 1 - 6 C atoms are particularly preferred. At times, however, compounds of the general formula (I) containing branched substituents R_1 are also important, since these frequently have better solubility properties in the customary liquid crystal base mixtures. Such substituents R_1 which are not straight-chain preferably contain not more than one chain branch. Preferred branched substituents are those in which the carbon chain is branched at the linking carbon atom or one of the two adjacent carbon atoms. Amongst these substituents, important branched groups are those in which a methyl or ethyl group is located in the 1-, 2- or 3-position of a longer carbon chain, for example isopropyl, 1-methylpropyl, 2-methylpropyl, 1-methylbutyl, 2-methylbutyl, 3-methylbutyl, 1-methylpentyl, 1-ethylpentyl, 2-methylpentyl, 1-methylhexyl, 2-ethylhexyl or 1-methylheptyl.

If the substituent R_2 in the compounds of the general formula (I) is an alkyl group, what has been stated above in respect of the substituent R_1 applies in respect of this group. Analogously, this also applies in respect of the alkyl part of an alkoxy or alkanoyloxy group located on a phenyl ring B, this alkyl part of an alkanoyloxy group, however, having not more than 7 carbon atoms. Preferably,

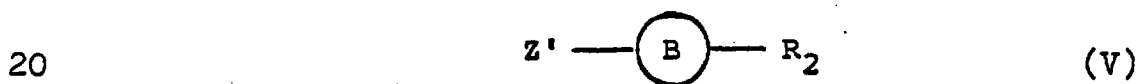
however, the compounds of the general formula (I) contain not more than one substituent with a branched carbon chain; cyclohexane derivatives according to the invention which are of the greatest importance are those in which the two end groups R_1 and R_2 contain straight-chain carbon chains.

If the ring B is a phenyl ring, the compounds containing the cyano group as the end group R_2 are particularly preferred.

The cyclohexane derivatives according to the invention are prepared by standard processes which are frequently described in the literature for carboxylic acid esters. Preferably, the new compounds are prepared by reacting a cyclohexane compound of the general formula (IV)



in which Z is OH, OMe, COOH or a reactive derivative of the carboxyl group and Me is an equivalent of a metal cation, at a temperature between -50°C and $+250^\circ\text{C}$, optionally in the presence of an organic solvent and/or of a conventional esterification catalyst, with a compound of the general formula (V)



in which Z' is COOH or a reactive derivative of the carboxyl group if Z is OH or OMe and Z' is OH or OMe if Z is COOH or a reactive carboxyl group derivative. 4-(4- R_1 -Cyclohexyl)-benzoic acid esters or 4-(4- R_1 -cyclohexyl)-cyclohexane-carboxylic acid esters are obtained if Z is COOH or a reactive derivative thereof, preferably -CO-halogen, especially

-COCl, -COO-lower alkyl, especially -COOCH₃, or an anhydride grouping, preferably a mixed anhydride, such as, for example, -COOCOCH₃. The group Z' in the compound of the formula (V) in this case is a hydroxyl group or an alcoholate group, preferably an alkali metal alcoholate or alkaline earth metal alcoholate group. The reaction conditions for the process according to the invention are substantially determined by the nature of the groups Z and Z'. Thus, a carboxylic acid is reacted with an alcohol (Z, Z' = COOH, OH) as a rule in the presence of a strong acid, for example a mineral acid, such as hydrochloric acid or sulphuric acid. A preferred reaction procedure is the reaction of an acid anhydride or, in particular, of an acid chloride with an alcohol (Z, Z' = COCl, OH). Preferably, these esterification reactions are carried out in an alkaline medium and important bases are, in particular, alkali metal hydroxides, such as sodium hydroxide or potassium hydroxide, alkali metal carbonates and alkali metal 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.

The esterification reactions are advantageously carried out in the presence of an inert solvent. Solvents which are very suitable are, in particular, ethers such as diethyl ether, di-n-butyl ether, tetrahydrofuran, dioxan or anisole, ketones such as acetone, butanone, pentan-3-one or cyclohexanone, amides such as dimethylformamide or hexa-

methylphosphoric acid triamide, hydrocarbons such as benzene, toluene or xylene, halogenated hydrocarbons such as carbon tetrachloride or tetrachloroethylene, and sulphoxides such as dimethylsulphoxide or sulpholane. Water-immiscible solvents can at the same time advantageously be used for the removal, by azeotropic distillation, of the water formed during the esterification reaction. An excess of an organic base used, for example pyridine, quinoline or triethylamine, can sometimes also be employed as the solvent for the esterification reaction. In principle, the esterification reactions according to the invention 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°C and + 250°C and preferably between - 20°C and + 80°C. At these temperatures, the esterification reactions as a rule have ended after 15 minutes to 48 hours.

A further preferred embodiment of the process according to the invention comprises first converting the alcohol of the formula IV or V (Z or $Z' = OH$), which is to be esterified, to its sodium or potassium salt, for example by treatment with ethanolic sodium hydroxide solution or potassium hydroxide solution, isolating this salt and suspending it together with sodium bicarbonate or potassium carbonate in acetone or diethyl ether, with stirring, and adding a solution of an acid chloride or anhydride in diethyl ether, acetone or dimethylformamide dropwise to this suspension, with stirring. The reaction mixture is kept

at a temperature between -25°C and $+20^{\circ}\text{C}$, preferably at -10°C to -20°C . With this procedure, the esterification reaction usually has ended after 15 to 50 minutes.

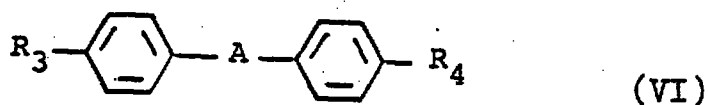
The starting materials for the preparation of the
5 cyclohexane derivatives according to the invention are known in some cases, such as, for example, the alcohols or carboxylic acids of the general formula (V), which are substituted in the 4-position, and in some cases can be prepared without difficulty by standard processes of organic
10 chemistry from compounds known from the literature. Thus, for example, the carboxylic acids of the general formula (IV) ($Z = \text{COOH}$) are intermediate products in the syntheses of the phenylcyclohexanes and cyclohexylcyclohexanes described in German Patent Application P 26 36 684 and
15 P 27 02 548.

The 4-(4- R_1 -cyclohexyl)-phenols of the general formula (IV) ($Z = \text{OH}$) can be prepared, for example, by reacting the corresponding 4- R_1 -cyclohexanones with 4-methoxyphenylmagnesium bromide, subjecting the reaction product to an
20 acid treatment in order to hydrolyse the magnesium-organic compound, the methoxy group undergoing ether scission at the same time, separating the resulting mixture of stereoisomers by chromatography and reducing the tertiary alicyclic hydroxyl group catalytically with retention or inversion of
25 the configuration. The 4-(4- R_1 -cyclohexyl)-cyclohexanols can be prepared by catalytic hydrogenation under more vigorous conditions from the 4-(4- R_1 -cyclohexyl)-phenols thus obtained.

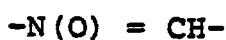
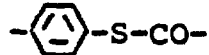
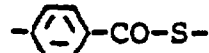
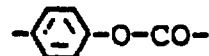
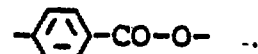
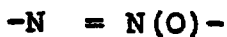
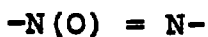
The compounds of the general formula (I) are valu-

able components of liquid crystal dielectrics, which are used to prepare electro-optical display elements.

The dielectrics according to the invention consist of two or more components including at least one of the general formula (I). The further components are preferably nematic or nematogenic substances from the categories of the azobenzenes, azoxybenzenes, biphenyls, Schiff's bases, especially benzylidene derivatives, phenylbenzoates, phenylcyclohexanes, optionally halogenated stilbenes, diphenylacetylene derivatives, diphenylnitrones and substituted cinnamic acids. The most important compounds which can be used as such further components can be characterised by the general formula (VI)



in which A is



or a C-C single bond;

if A is $-\text{CO}-\text{O}-$, $-\text{O}-\text{CO}-$ or a C-C single bond, one of the two phenyl rings can also be replaced by a trans-cyclohexyl ring;

X' is halogen, preferably Cl. R₃ and R₄ are identical or different and can be alkyl, alkoxy, alkanoyl, alkanoyloxy or alkoxycarbonyloxy radicals with up to 18 and preferably up to 8 C atoms; furthermore, one of these radicals can also be a cyano, nitro or isonitrile group. In most of these compounds, R₃ and R₄ are preferably different and one of the radicals is usually an alkyl or alkoxy group. However, a large number of other variants of the envisaged substituents are commonly used. Many such nematic substances are available commercially.

The dielectrics according to the invention contain up to 50, usually 1 - 40 and preferably 5 - 40 parts by weight of one or more compounds of the formula (I).

By means of these additives - depending on the nature and composition of the liquid crystal base substance - increases of 5 to 40° in the clear point are achieved without the viscosity of the base substance, and thus the switching time of display elements prepared with such dielectrics, being changed in an undesirable manner.

At the same time, the temperature dependence of the threshold voltage is surprisingly low in the dielectrics according to the invention.

By means of suitable additives, the liquid crystal dielectrics according to the invention can be so modified that they can be used in all of the types of display elements disclosed hitherto. Such additives are known to those skilled in the art and are described in detail in the relevant literature. For example, substances to change the dielectric anisotropy and/or the orientation of the

nematic phases can be added. Such substances are described, for example, in German Offenlegungsschriften 2,209,127, 2,321,632 and 2,611,453.

The examples which follow are intended to illustrate the invention without restricting it. In the examples, m.p. denotes the melting point, S./N. denotes the transition point from a smectic to a nematic phase and Cl. denotes the clear point of a liquid crystal substance in degrees centigrade; boiling points are designated b.p. Unless stated otherwise, parts or percentage data are parts by weight and per cent by weight.

Example 1

A solution of 29.3 g of 4-(4-n-pentylcyclohexyl)-benzoyl chloride (prepared according to Example 1 of German Patent Application P 26 36 684) in 120 ml of toluene is added dropwise in the course of 2 hours to a boiling solution of 16.5 g of 4-n-pentylphenol and 10 ml of pyridine in 120 ml of toluene, with stirring. The reaction mixture is heated to the boil under reflux for a further 3 hours and is then evaporated. 100 ml of water are added to the residue and the mixture is extracted with three times 150 ml of diethyl ether. The ether extracts are washed with 200 ml of water, 150 ml of 5% sodium bicarbonate solution and a further 200 ml of water and dried over sodium sulphate. After distilling off the ether, the residual 4'-n-pentylphenyl 4-(4-n-pentylcyclohexyl)-benzoate is recrystallised from ethanol; m.p. 97°C, S/N. 133°C, Cl. 169°C.

The following compounds are prepared analogously: 4'-methylphenyl 4-(4-methylcyclohexyl)-benzoate,

- 4'-ethylphenyl 4-(4-methylcyclohexyl)-benzoate,
4'-n-propylphenyl 4-(4-methylcyclohexyl)-benzoate,
4'-n-butylphenyl 4-(4-methylcyclohexyl)-benzoate,
4'-n-pentylphenyl 4-(4-methylcyclohexyl)-benzoate,
5 4'-n-hexylphenyl 4-(4-methylcyclohexyl)-benzoate,
4'-n-heptylphenyl 4-(4-methylcyclohexyl)-benzoate,
4'-n-octylphenyl 4-(4-methylcyclohexyl)-benzoate,
4'-(2-methylbutyl)-phenyl 4-(4-methylcyclohexyl)-benzoate,
4'-cyanophenyl 4-(4-methylcyclohexyl)-benzoate,
10 m.p. 153°C, Cl. 202°C;
4'-methoxyphenyl 4-(4-methylcyclohexyl)-benzoate,
4'-ethoxyphenyl 4-(4-methylcyclohexyl)-benzoate,
4'-n-propoxyphenyl 4-(4-methylcyclohexyl)-benzoate,
4'-n-butoxyphenyl 4-(4-methylcyclohexyl)-benzoate,
15 4'-n-pentyloxyphenyl 4-(4-methylcyclohexyl)-benzoate,
4'-n-hexyloxyphenyl 4-(4-methylcyclohexyl)-benzoate,
4'-acetoxypheyl 4-(4-methylcyclohexyl)-benzoate,
4'-propionyloxyphenyl 4-(4-methylcyclohexyl)-benzoate,
4'-n-butanoyloxyphenyl 4-(4-methylcyclohexyl)-benzoate,
20 4'-n-pentanoyloxyphenyl 4-(4-methylcyclohexyl)-benzoate,
4'-n-hexanoyloxyphenyl 4-(4-methylcyclohexyl)-benzoate,
4'-n-heptanoyloxyphenyl 4-(4-methylcyclohexyl)-benzoate,
4'-methylphenyl 4-(4-ethylcyclohexyl)-benzoate,
m.p. 114°C, Cl. 162°C;
25 4'-ethylphenyl 4-(4-ethylcyclohexyl)-benzoate,
m.p. 94°C, Cl. 149°C;
4'-n-propylphenyl 4-(4-ethylcyclohexyl)-benzoate,
m.p. 74°C, Cl. 160°C;
4'-n-butylphenyl 4-(4-ethylcyclohexyl)-benzoate,

- m.p. 83°C, Cl. 148°C;
4'-n-pentylphenyl 4-(4-ethylcyclohexyl)-benzoate,
m.p. 79°C, Cl. 152°C;
4'-n-hexylphenyl 4-(4-ethylcyclohexyl)-benzoate,
5 m.p. 75°C, Cl. 141°C;
4'-n-heptylphenyl 4-(4-ethylcyclohexyl)-benzoate,
4'-(2-methylbutyl)-phenyl 4-(4-ethylcyclohexyl)-benzoate,
4'-cyanophenyl 4-(4-ethylcyclohexyl)-benzoate,
m.p. 113°C, Cl. 215°C;
- 10 4'-methoxyphenyl 4-(4-ethylcyclohexyl)-benzoate,
4'-ethoxyphenyl 4-(4-ethylcyclohexyl)-benzoate,
4'-n-propoxyphenyl 4-(4-ethylcyclohexyl)-benzoate,
4'-n-butoxyphenyl 4-(4-ethylcyclohexyl)-benzoate,
4'-n-pentyloxyphenyl 4-(4-ethylcyclohexyl)-benzoate,
15 4'-n-hexyloxyphenyl 4-(4-ethylcyclohexyl)-benzoate,
4'-acetoxyphenyl 4-(4-ethylcyclohexyl)-benzoate,
4'-propionyloxyphenyl 4-(4-ethylcyclohexyl)-benzoate,
4'-n-butanoyloxyphenyl 4-(4-ethylcyclohexyl)-benzoate,
4'-n-pentanoyloxyphenyl 4-(4-ethylcyclohexyl)-benzoate,
20 4'-n-hexanoyloxyphenyl 4-(4-ethylcyclohexyl)-benzoate,
4'-n-heptanoyloxyphenyl 4-(4-ethylcyclohexyl)-benzoate,
4'-methylphenyl 4-(4-n-propylcyclohexyl)-benzoate,
m.p. 122°C, Cl. 189°C;
4'-ethylphenyl 4-(4-n-propylcyclohexyl)-benzoate,
- 25 m.p. 105°C, Cl. 177°C;
4'-n-propylphenyl 4-(4-n-propylcyclohexyl)-benzoate,
m.p. 78°C, S./N. 87°C, Cl. 186°C;
4'-n-butylphenyl 4-(4-n-propylcyclohexyl)-benzoate,
m.p. 88°C, Cl. 165°C;

- 4'-n-pentylphenyl 4-(4-n-propylcyclohexyl)-benzoate,
m.p. 86°C, Cl. 173°C;
- 4'-n-hexylphenyl 4-(4-n-propylcyclohexyl)-benzoate,
m.p. 72°C, S./N. 103°C, Cl. 165°C;
- 5 4'-n-heptylphenyl 4-(4-n-propylcyclohexyl)-benzoate,
4'-(2-methylbutyl)-phenyl 4-(4-n-propylcyclohexyl)-benzoate,
4'-cyanophenyl 4-(4-n-propylcyclohexyl)-benzoate,
m.p. 122°C, Cl. 227°C;
- 4'-methoxyphenyl 4-(4-n-propylcyclohexyl)-benzoate,
- 10 4'-ethoxyphenyl 4-(4-n-propylcyclohexyl)-benzoate,
4'-n-propoxyphenyl 4-(4-n-propylcyclohexyl)-benzoate,
4'-n-butoxyphenyl 4-(4-n-propylcyclohexyl)-benzoate,
4'-n-pentyloxyphenyl 4-(4-n-propylcyclohexyl)-benzoate,
4'-n-hexyloxyphenyl 4-(4-n-propylcyclohexyl)-benzoate,
- 15 4'-acetoxyphehyl 4-(4-n-propylcyclohexyl)-benzoate,
4'-propionyloxyphenyl 4-(4-n-propylcyclohexyl)-benzoate,
4'-n-butanoyloxyphenyl 4-(4-n-propylcyclohexyl)-benzoate,
4'-n-pentanoyloxyphenyl 4-(4-n-propylcyclohexyl)-benzoate,
4'-n-hexanoyloxyphenyl 4-(4-n-propylcyclohexyl)-benzoate,
- 20 4'-n-heptanoyloxyphenyl 4-(4-n-propylcyclohexyl)-benzoate,
4'-methylphenyl 4-(4-n-butylcyclohexyl)-benzoate,
m.p. 115°C, Cl. 180°C;
- 4'-ethylphenyl 4-(4-n-butylcyclohexyl)-benzoate,
m.p. 101°C, Cl. 168°C;
- 25 4'-n-propylphenyl 4-(4-n-butylcyclohexyl)-benzoate,
m.p. 86°C, S./N. 90°C, Cl. 176°C;
- 4'-n-butylphenyl 4-(4-n-butylcyclohexyl)-benzoate,
m.p. 91°C, S./N. 110°C, Cl. 165°C;
- 4'-n-pentylphenyl 4-(4-n-butylcyclohexyl)-benzoate,

m.p. 83°C, S./N. 109°C, Cl. 165°C;

4'-n-hexylphenyl 4-(4-n-butylcyclohexyl)-benzoate,

m.p. 88°C, S./N. 120°C, Cl. 159°C;

4'-n-heptylphenyl 4-(4-n-butylcyclohexyl)-benzoate,

5 4'-(2-methylbutyl)-phenyl 4-(4-n-butylcyclohexyl)-benzoate,

4'-cyanophenyl 4-(4-n-butylcyclohexyl)-benzoate,

m.p. 104°C, Cl. 224°C;

4'-methoxyphenyl 4-(4-n-butylcyclohexyl)-benzoate,

4'-ethoxyphenyl 4-(4-n-butylcyclohexyl)-benzoate,

10 4'-n-propoxyphenyl 4-(4-n-butylcyclohexyl)-benzoate,

4'-n-butoxyphenyl 4-(4-n-butylcyclohexyl)-benzoate,

4'-n-pentyloxyphenyl 4-(4-n-butylcyclohexyl)-benzoate,

4'-n-hexyloxyphenyl 4-(4-n-butylcyclohexyl)-benzoate,

4'-acetoxyphephenyl 4-(4-n-butylcyclohexyl)-benzoate,

15 4'-propionyloxyphenyl 4-(4-n-butylcyclohexyl)-benzoate,

4'-n-butanoyloxyphenyl 4-(4-n-butylcyclohexyl)-benzoate,

4'-n-pentanoyloxyphenyl 4-(4-n-butylcyclohexyl)-benzoate,

4'-n-hexanoyloxyphenyl 4-(4-n-butylcyclohexyl)-benzoate,

4'-methylphenyl 4-(4-n-pentylcyclohexyl)-benzoate,

20 m.p. 108°C, Cl. 183°C;

4'-ethylphenyl 4-(4-n-pentylcyclohexyl)-benzoate,

- m.p. 90°C, S./N. 106°C, Cl. 171°C;

4'-n-propylphenyl 4-(4-n-pentylcyclohexyl)-benzoate,

m.p. 66°C, S./N. 119°C, Cl. 184°C;

25 4'-n-butylphenyl 4-(4-n-pentylcyclohexyl)-benzoate,

m.p. 74°C, S./N. 132°C, Cl. 169°C;

4'-n-hexylphenyl 4-(4-n-pentylcyclohexyl)-benzoate,

m.p. 103°C, S./N. 138°C, Cl. 163°C;

4'-n-heptylphenyl 4-(4-n-pentylcyclohexyl)-benzoate,

- 4'-(2-methylbutyl)-phenyl 4-(4-n-pentylcyclohexyl)-benzoate,
4'-cyanophenyl 4-(4-n-pentylcyclohexyl)-benzoate,
m.p. 103°C, Cl. 217°C;
4'-methoxyphenyl 4-(4-n-pentylcyclohexyl)-benzoate,
5 4'-ethoxyphenyl 4-(4-n-pentylcyclohexyl)-benzoate,
4'-n-propoxyphenyl 4-(4-n-pentylcyclohexyl)-benzoate,
4'-n-butoxyphenyl 4-(4-n-pentylcyclohexyl)-benzoate,
4'-n-pentyloxyphenyl 4-(4-n-pentylcyclohexyl)-benzoate,
4'-n-hexyloxyphenyl 4-(4-n-pentylcyclohexyl)-benzoate,
10 4'-acetoxypheyl 4-(4-n-pentylcyclohexyl)-benzoate,
4'-propionyloxyphenyl 4-(4-n-pentylcyclohexyl)-benzoate,
4'-n-butanoyloxyphenyl 4-(4-n-pentylcyclohexyl)-benzoate,
4'-n-pentanoyloxyphenyl 4-(4-n-pentylcyclohexyl)-benzoate,
4'-n-hexanoyloxyphenyl 4-(4-n-pentylcyclohexyl)-benzoate,
15 4'-methylphenyl 4-(4-n-hexylcyclohexyl)-benzoate,
4'-ethylphenyl 4-(4-n-hexylcyclohexyl)-benzoate,
4'-n-propylphenyl 4-(4-n-hexylcyclohexyl)-benzoate,
4'-n-butylphenyl 4-(4-n-hexylcyclohexyl)-benzoate,
4'-n-pentylphenyl 4-(4-n-hexylcyclohexyl)-benzoate,
20 4'-n-hexylphenyl 4-(4-n-hexylcyclohexyl)-benzoate,
4'-(2-methylbutyl)-phenyl 4-(4-n-hexylcyclohexyl)-benzoate,
4'-cyanophenyl 4-(4-n-hexylcyclohexyl)-benzoate,
m.p. 101°C, Cl. 208°C;
4'-methoxyphenyl 4-(4-n-hexylcyclohexyl)-benzoate,
25 4'-ethoxyphenyl 4-(4-n-hexylcyclohexyl)-benzoate,
4'-n-propoxyphenyl 4-(4-n-hexylcyclohexyl)-benzoate,
4'-n-butoxyphenyl 4-(4-n-hexylcyclohexyl)-benzoate,
4'-acetoxypheyl 4-(4-n-hexylcyclohexyl)-benzoate,
4'-propionyloxyphenyl 4-(4-n-hexylcyclohexyl)-benzoate,

- 4'-n-butanoyloxyphenyl 4-(4-n-hexylcyclohexyl)-benzoate,
4'-n-pentanoyloxyphenyl 4-(4-n-hexylcyclohexyl)-benzoate,
4'-methylphenyl 4-(4-n-heptylcyclohexyl)-benzoate,
4'-ethylphenyl 4-(4-n-heptylcyclohexyl)-benzoate,
5 4'-n-propylphenyl 4-(4-n-heptylcyclohexyl)-benzoate,
4'-n-butylphenyl 4-(4-n-heptylcyclohexyl)-benzoate,
4'-n-pentylphenyl 4-(4-n-heptylcyclohexyl)-benzoate,
m.p. 115°C, S./N. 147°C, Cl. 162°C;
4'-(2-methylbutyl)-phenyl 4-(4-n-heptylcyclohexyl)-benzoate,
10 4'-cyanophenyl 4-(4-n-heptylcyclohexyl)-benzoate,
m.p. 104°C, Cl. 211°C;
4'-methoxyphenyl 4-(4-n-heptylcyclohexyl)-benzoate,
4'-ethoxyphenyl 4-(4-n-heptylcyclohexyl)-benzoate,
4'-n-propoxyphenyl 4-(4-n-heptylcyclohexyl)-benzoate,
15 4'-n-butoxyphenyl 4-(4-n-heptylcyclohexyl)-benzoate,
4'-acetoxyphephenyl 4-(4-n-heptylcyclohexyl)-benzoate,
4'-propionyloxyphenyl 4-(4-n-heptylcyclohexyl)-benzoate,
4'-n-butanoyloxyphenyl 4-(4-n-heptylcyclohexyl)-benzoate,
4'-n-pentanoyloxyphenyl 4-(4-n-heptylcyclohexyl)-benzoate,
20 4'-methylphenyl 4-(4-n-octylcyclohexyl)-benzoate,
4'-ethylphenyl 4-(4-n-octylcyclohexyl)-benzoate,
4'-n-propylphenyl 4-(4-n-octylcyclohexyl)-benzoate,
4'-n-butylphenyl 4-(4-n-octylcyclohexyl)-benzoate,
4'-(2-methylbutyl)-phenyl 4-(4-n-octylcyclohexyl)-benzoate,
25 4'-cyanophenyl 4-(4-n-octylcyclohexyl)-benzoate,
4'-methoxyphenyl 4-(4-n-octylcyclohexyl)-benzoate,
4'-ethoxyphenyl 4-(4-n-octylcyclohexyl)-benzoate,
4'-n-propoxyphenyl 4-(4-n-octylcyclohexyl)-benzoate,
4'-n-butoxyphenyl 4-(4-n-octylcyclohexyl)-benzoate,

- 4'-acetoxyphenyl 4-(4-n-octylcyclohexyl)-benzoate,
4'-propionyloxyphenyl 4-(4-n-octylcyclohexyl)-benzoate,
4'-n-butanoyloxyphenyl 4-(4-n-octylcyclohexyl)-benzoate,
4'-methylphenyl 4-[4-(2-methylbutyl)-cyclohexyl]-benzoate,
5 4'-ethylphenyl 4-[4-(2-methylbutyl)-cyclohexyl]-benzoate,
4'-n-propylphenyl 4-[4-(2-methylbutyl)-cyclohexyl]-benzoate,
4'-n-butylphenyl 4-[4-(2-methylbutyl)-cyclohexyl]-benzoate,
4'-n-pentylphenyl 4-[4-(2-methylbutyl)-cyclohexyl]-benzoate,
4'-n-hexylphenyl 4-[4-(2-methylbutyl)-cyclohexyl]-benzoate,
10 4'-n-heptylphenyl 4-[4-(2-methylbutyl)-cyclohexyl]-benzoate,
4'-n-octylphenyl 4-[4-(2-methylbutyl)-cyclohexyl]-benzoate,
4'-cyanophenyl 4-[4-(2-methylbutyl)-cyclohexyl]-benzoate,
4'-methoxyphenyl 4-[4-(2-methylbutyl)-cyclohexyl]-benzoate,
4'-ethoxyphenyl 4-[4-(2-methylbutyl)-cyclohexyl]-benzoate,
15 4'-n-propoxyphenyl 4-[4-(2-methylbutyl)-cyclohexyl]-benzoate,
4'-n-butoxyphenyl 4-[4-(2-methylbutyl)-cyclohexyl]-benzoate,
4'-n-pentyloxyphenyl 4-[4-(2-methylbutyl)-cyclohexyl]-
benzoate,
4'-n-hexyloxyphenyl 4-[4-(2-methylbutyl)-cyclohexyl]-
20 benzoate,
4'-acetoxyphenyl 4-[4-(2-methylbutyl)-cyclohexyl]-benzoate,
4'-propionyloxyphenyl 4-[4-(2-methylbutyl)-cyclohexyl]-
benzoate,
4'-n-butanoyloxyphenyl 4-[4-(2-methylbutyl)-cyclohexyl]-
25 benzoate,
4'-n-pentanoyloxyphenyl 4-[4-(2-methylbutyl)-cyclohexyl]-
benzoate,
4'-n-hexanoyloxyphenyl 4-[4-(2-methylbutyl)-cyclohexyl]-
benzoate,

- 4'-n-heptanoyloxyphenyl 4-[4-(2-methylbutyl)-cyclohexyl]-benzoate,
- 4'-methylcyclohexyl 4-(4-methylcyclohexyl)-benzoate,
- 4'-ethylcyclohexyl 4-(4-methylcyclohexyl)-benzoate,
- 5 m.p. 112°C, Cl. 100°C;
- 4'-n-propylcyclohexyl 4-(4-methylcyclohexyl)-benzoate,
- m.p. 95°C, Cl. 125°C;
- 4'-n-butylcyclohexyl 4-(4-methylcyclohexyl)-benzoate,
- m.p. 75°C, S./N. 83°C, Cl. 115°C;
- 10 4'-n-pentylcyclohexyl 4-(4-methylcyclohexyl)-benzoate,
- m.p. 88°C, Cl. 122°C;
- 4'-n-hexylcyclohexyl 4-(4-methylcyclohexyl)-benzoate,
- 4'-n-heptylcyclohexyl 4-(4-methylcyclohexyl)-benzoate,
- 4'-n-octylcyclohexyl 4-(4-methylcyclohexyl)-benzoate,
- 15 4'-methylcyclohexyl 4-(4-ethylcyclohexyl)-benzoate,
- 4'-ethylcyclohexyl 4-(4-ethylcyclohexyl)-benzoate,
- m.p. 188°C, Cl. 111°C;
- 4'-n-propylcyclohexyl 4-(4-ethylcyclohexyl)-benzoate,
- m.p. 93°C, Cl. 133°C;
- 20 4'-n-butylcyclohexyl 4-(4-ethylcyclohexyl)-benzoate,
- 4'-n-pentylcyclohexyl 4-(4-ethylcyclohexyl)-benzoate,
- m.p. 68°C, Cl. 128°C;
- 4'-n-hexylcyclohexyl 4-(4-ethylcyclohexyl)-benzoate,
- 4'-n-heptylcyclohexyl 4-(4-ethylcyclohexyl)-benzoate,
- 25 4'-methylcyclohexyl 4-(4-n-propylcyclohexyl)-benzoate,
- m.p. 90°C, Cl. 127.5°C;
- 4'-ethylcyclohexyl 4-(4-n-propylcyclohexyl)-benzoate,
- m.p. 93°C, Cl. 135°C;
- 4'-n-propylcyclohexyl 4-(4-n-propylcyclohexyl)-benzoate,

- m.p. 92°C, Cl. 158°C;
4'-n-butylcyclohexyl 4-(4-n-propylcyclohexyl)-benzoate,
m.p. 76°C, Cl. 147°C.
4'-n-pentylcyclohexyl 4-(4-n-propylcyclohexyl)-benzoate,
5 m.p. 68°C, S./N. 74°C, Cl. 153°C;
4'-n-hexylcyclohexyl 4-(4-n-propylcyclohexyl)-benzoate,
4'-n-heptylcyclohexyl 4-(4-n-propylcyclohexyl)-benzoate,
4'-methylcyclohexyl 4-(4-n-butylcyclohexyl)-benzoate,
4'-ethylcyclohexyl 4-(4-n-butylcyclohexyl)-benzoate,
10 m.p. 76°C, Cl.
4'-n-propylcyclohexyl 4-(4-n-butylcyclohexyl)-benzoate,
m.p. 69°C, Cl. 150°C;
4'-n-butylcyclohexyl 4-(4-n-butylcyclohexyl)-benzoate,
m.p. 81°C, Cl. 143°C;
15 4'-n-pentylcyclohexyl 4-(4-n-butylcyclohexyl)-benzoate,
m.p. 62°C, Cl. 147°C;
4'-n-hexylcyclohexyl 4-(4-n-butylcyclohexyl)-benzoate,
4'-n-heptylcyclohexyl 4-(4-n-butylcyclohexyl)-benzoate,
m.p. 55°C, S./N. 77°C, Cl. 138°C;
20 4'-methylcyclohexyl 4-(4-n-pentylcyclohexyl)-benzoate,
m.p. 67.5°C, S./N. 70°C, Cl. 123°C;
4'-ethylcyclohexyl 4-(4-n-pentylcyclohexyl)-benzoate,
m.p. 75°C, Cl. 134°C;
4'-n-propylcyclohexyl 4-(4-n-pentylcyclohexyl)-benzoate,
25 m.p. 60°C, Cl. 145°C;
4'-n-butylcyclohexyl 4-(4-n-pentylcyclohexyl)-benzoate,
m.p. 72°C, S./N. 82°C, Cl. 147°C;
4'-n-pentylcyclohexyl 4-(4-n-pentylcyclohexyl)-benzoate,
m.p. 70°C, S./N. 90°C, Cl. 156°C;

- 4'-n-hexylcyclohexyl 4-(4-n-pentylcyclohexyl)-benzoate,
4'-n-heptylcyclohexyl 4-(4-n-pentylcyclohexyl)-benzoate,
4'-methylcyclohexyl 4-(4-n-hexylcyclohexyl)-benzoate,
4'-ethylcyclohexyl 4-(4-n-hexylcyclohexyl)-benzoate,
5 4'-n-propylcyclohexyl 4-(4-n-hexylcyclohexyl)-benzoate,
4'-n-butylcyclohexyl 4-(4-n-hexylcyclohexyl)-benzoate,
4'-n-pentylcyclohexyl 4-(4-n-hexylcyclohexyl)-benzoate,
4'-n-hexylcyclohexyl 4-(4-n-hexylcyclohexyl)-benzoate,
4'-n-heptylcyclohexyl 4-(4-n-hexylcyclohexyl)-benzoate,
10 m.p. 65°C, S./N. 115°C, Cl. 141°C;
4'-methylcyclohexyl 4-(4-n-heptylcyclohexyl)-benzoate,
4'-ethylcyclohexyl 4-(4-n-heptylcyclohexyl)-benzoate,
m.p. 78°C, Cl. 123°C;
4'-n-propylcyclohexyl 4-(4-n-heptylcyclohexyl)-benzoate,
15 m.p. 65°C, S./N. 85°C, Cl. 141°C;
4'-n-butylcyclohexyl 4-(4-n-heptylcyclohexyl)-benzoate,
m.p. 68°C, S./N. 103°C, Cl. 139°C;
4'-n-pentylcyclohexyl 4-(4-n-heptylcyclohexyl)-benzoate,
m.p. 60°C, S./N. 100°C, Cl. 135°C;
20 4'-methylcyclohexyl 4-(4-n-octylcyclohexyl)-benzoate,
4'-ethylcyclohexyl 4-(4-n-octylcyclohexyl)-benzoate,
4'-n-propylcyclohexyl 4-(4-n-octylcyclohexyl)-benzoate,
4'-methylcyclohexyl 4-[4-(2-methylbutyl)-cyclohexyl]-
benzoate,
25 4'-ethylcyclohexyl 4-[4-(2-methylbutyl)-cyclohexyl]-benzoate,
4'-n-propylcyclohexyl 4-[4-(2-methylbutyl)-cyclohexyl]-
benzoate,
4'-n-butylcyclohexyl 4-[4-(2-methylbutyl)-cyclohexyl]-
benzoate,

- 4'-n-pentylcyclohexyl 4-[4-(2-méthylbutyl)-cyclohexyl]-benzoate,
- 4'-n-hexylcyclohexyl 4-[4-(2-methylbutyl)-cyclohexyl]-benzoate,
- 5 4'-n-heptylcyclohexyl 4-[4-(2-methylbutyl)-cyclohexyl]-benzoate,
- 4'-n-octylcyclohexyl 4-[4-(2-methylbutyl)-cyclohexyl]-benzoate,
- 4'-methylcyclohexyl 4-(4-methylcyclohexyl)-cyclohexane-10 carboxylate,
- 4'-ethylcyclohexyl 4-(4-methylcyclohexyl)-cyclohexane-carboxylate,
- 4'-n-propylcyclohexyl 4-(4-methylcyclohexyl)-cyclohexane-carboxylate,
- 15 4'-n-butylcyclohexyl 4-(4-methylcyclohexyl)-cyclohexane-carboxylate,
- 4'-n-pentylcyclohexyl 4-(4-methylcyclohexyl)-cyclohexane-carboxylate,
- 4'-n-hexylcyclohexyl 4-(4-methylcyclohexyl)-cyclohexane-20 carboxylate,
- 4'-n-heptylcyclohexyl 4-(4-methylcyclohexyl)-cyclohexane-carboxylate,
- 4'-n-octylcyclohexyl 4-(4-methylcyclohexyl)-cyclohexane-carboxylate,
- 25 4'-methylcyclohexyl 4-(4-ethylcyclohexyl)-cyclohexane-carboxylate,
- 4'-ethylcyclohexyl 4-(4-ethylcyclohexyl)-cyclohexane-carboxylate,
- 4'-n-propylcyclohexyl 4-(4-ethylcyclohexyl)-cyclohexane-

- carboxylate,
- 4'-n-butylcyclohexyl 4-(4-ethylcyclohexyl)-cyclohexane-carboxylate,
- 4'-n-pentylcyclohexyl 4-(4-ethylcyclohexyl)-cyclohexane-
- 5 carboxylate,
- 4'-n-hexylcyclohexyl 4-(4-ethylcyclohexyl)-cyclohexane-carboxylate,
- 4'-n-heptylcyclohexyl 4-(4-ethylcyclohexyl)-cyclohexane-carboxylate,
- 10 4'-methylcyclohexyl 4-(4-n-propylcyclohexyl)-cyclohexane-carboxylate,
- 4'-ethylcyclohexyl 4-(4-n-propylcyclohexyl)-cyclohexane-carboxylate,
- 4'-n-propylcyclohexyl 4-(4-n-propylcyclohexyl)-cyclohexane-
- 15 carboxylate,
- 4'-n-butylcyclohexyl 4-(4-n-propylcyclohexyl)-cyclohexane-carboxylate,
- 4'-n-pentylcyclohexyl 4-(4-n-propylcyclohexyl)-cyclohexane-carboxylate,
- 20 4'-n-hexylcyclohexyl 4-(4-n-propylcyclohexyl)-cyclohexane-carboxylate,
- 4'-n-heptylcyclohexyl 4-(4-n-propylcyclohexyl)-cyclohexane-carboxylate,
- m.p. 54°C, Cl. 182°C;
- 25 4'-methylcyclohexyl 4-(4-n-butylcyclohexyl)-cyclohexane-carboxylate,
- 4'-ethylcyclohexyl 4-(4-n-butylcyclohexyl)-cyclohexane-carboxylate,
- 4'-n-propylcyclohexyl 4-(4-n-butylcyclohexyl)-cyclohexane-

- carboxylate,
4'-n-butylcyclohexyl 4-(4-n-butylcyclohexyl)-cyclohexane-
carboxylate,
4'-n-pentylcyclohexyl 4-(4-n-butylcyclohexyl)-cyclohexane-
5 carboxylate,
4'-n-hexylcyclohexyl 4-(4-n-butylcyclohexyl)-cyclohexane-
carboxylate,
4'-n-heptylcyclohexyl 4-(4-n-butylcyclohexyl)-cyclohexane-
carboxylate,
10 4'-methylcyclohexyl 4-(4-n-pentylcyclohexyl)-cyclohexane-
carboxylate,
4'-ethylcyclohexyl 4-(4-n-pentylcyclohexyl)-cyclohexane-
carboxylate,
4'-n-propylcyclohexyl 4-(4-n-pentylcyclohexyl)-cyclohexane-
15 carboxylate,
m.p. 64°C, Cl. 182°C;
4'-n-butylcyclohexyl 4-(4-n-pentylcyclohexyl)-cyclohexane-
carboxylate,
4'-n-pentylcyclohexyl 4-(4-n-pentylcyclohexyl)-cyclohexane-
20 carboxylate,
4'-n-hexylcyclohexyl 4-(4-n-pentylcyclohexyl)-cyclohexane-
carboxylate,
4'-n-heptylcyclohexyl 4-(4-n-pentylcyclohexyl)-cyclohexane-
carboxylate,
25 4'-methylcyclohexyl 4-(4-n-hexylcyclohexyl)-cyclohexane-
carboxylate,
4'-ethylcyclohexyl 4-(4-n-hexylcyclohexyl)-cyclohexane-
carboxylate,
4'-n-propylcyclohexyl 4-(4-n-hexylcyclohexyl)-cyclohexane-

- carboxylate,
- 4'-n-butylcyclohexyl 4-(4-n-hexylcyclohexyl)-cyclohexane-
carboxylate,
- 4'-n-pentylcyclohexyl 4-(4-n-hexylcyclohexyl)-cyclohexane-
5 carboxylate,
- 4'-methylcyclohexyl 4-(4-n-heptylcyclohexyl)-cyclohexane-
carboxylate,
- 4'-ethylcyclohexyl 4-(4-n-heptylcyclohexyl)-cyclohexane-
carboxylate,
- 10 4'-n-propylcyclohexyl 4-(4-n-heptylcyclohexyl)-cyclohexane-
carboxylate,
- 4'-n-butylcyclohexyl 4-(4-n-heptylcyclohexyl)-cyclohexane-
carboxylate,
- 4'-n-pentylcyclohexyl 4-(4-n-heptylcyclohexyl)-cyclohexane-
15 carboxylate,
- 4'-methylcyclohexyl 4-(4-n-octylcyclohexyl)-cyclohexane-
carboxylate,
- 4'-ethylcyclohexyl 4-(4-n-octylcyclohexyl)-cyclohexane-
carboxylate,
- 20 4'-n-propylcyclohexyl 4-(4-n-octylcyclohexyl)-cyclohexane-
carboxylate,
- 4'-methylcyclohexyl 4-[4-(2-methylbutyl)-cyclohexyl]-
cyclohexanecarboxylate,
- 4'-ethylcyclohexyl 4-[4-(2-methylbutyl)-cyclohexyl]-cyclo-
25 hexanecarboxylate,
- 4'-n-propylcyclohexyl 4-[4-(2-methylbutyl)-cyclohexyl]-
cyclohexanecarboxylate,
- 4'-n-butylcyclohexyl 4-[4-(2-methylbutyl)-cyclohexyl]-
cyclohexanecarboxylate,

- 4'-n-pentylcyclohexyl 4-[4-(2-methylbutyl)-cyclohexyl]-
cyclohexanecarboxylate,
4'-n-hexylcyclohexyl 4-[4-(2-methylbutyl)-cyclohexyl]-
cyclohexanecarboxylate,
5 4'-n-heptylcyclohexyl 4-[4-(2-methylbutyl)-cyclohexyl]-
cyclohexanecarboxylate,
4'-n-octylcyclohexyl 4-[4-(2-methylbutyl)-cyclohexyl]-
cyclohexanecarboxylate,
4'-(4-methylcyclohexyl)-phenyl 4-cyanobenzoate,
10 4'-(4-ethylcyclohexyl)-phenyl 4-cyanobenzoate,
4'-(4-n-propylcyclohexyl)-phenyl 4-cyanobenzoate,
m.p. 160°C, Cl. 254°C;
4'-(4-n-butylcyclohexyl)-phenyl 4-cyanobenzoate,
m.p. 178°C, Cl. 252°C;
15 4'-(4-n-pentylcyclohexyl)-phenyl 4-cyanobenzoate,
4'-(4-n-hexylcyclohexyl)-phenyl 4-cyanobenzoate,
4'-(4-n-heptylcyclohexyl)-phenyl 4-cyanobenzoate,
m.p. 157°C, S./N. 167°C, Cl. 229°C;
4'-(4-n-octylcyclohexyl)-phenyl 4-cyanobenzoate,
20 4'-[4-(2-methylbutyl)-cyclohexyl]-phenyl 4-cyanobenzoate,
4'-(4-methylcyclohexyl)-cyclohexyl 4-cyanobenzoate,
4'-(4-ethylcyclohexyl)-cyclohexyl 4-cyanobenzoate,
4'-(4-n-propylcyclohexyl)-cyclohexyl 4-cyanobenzoate,
4'-(4-n-butylcyclohexyl)-cyclohexyl 4-cyanobenzoate,
25 4'-(4-n-pentylcyclohexyl)-cyclohexyl 4-cyanobenzoate,
4'-(4-n-hexylcyclohexyl)-cyclohexyl 4-cyanobenzoate,
4'-(4-n-heptylcyclohexyl)-cyclohexyl 4-cyanobenzoate,
4'-(4-n-octylcyclohexyl)-cyclohexyl 4-cyanobenzoate,
4'-[4-(2-methylbutyl)-cyclohexyl]-cyclohexyl 4-cyano-

benzoate,

- 4-(methylcyclohexyl)-phenyl 4-methylcyclohexanecarboxylate,
4-(4-ethylcyclohexyl)-phenyl 4-methylcyclohexanecarboxylate,
4-(4-n-propylcyclohexyl)-phenyl 4-methylcyclohexanecarboxylate,
5 4-(4-n-butylcyclohexyl)-phenyl 4-methylcyclohexanecarboxylate,
4-(4-n-pentylcyclohexyl)-phenyl 4-methylcyclohexanecarboxylate,
4-(4-n-hexylcyclohexyl)-phenyl 4-methylcyclohexanecarboxylate,
4-(4-n-heptylcyclohexyl)-phenyl 4-methylcyclohexanecarboxylate,
4-(4-methylcyclohexyl)-phenyl 4-ethylcyclohexanecarboxylate,
10 4-(4-ethylcyclohexyl)-phenyl 4-ethylcyclohexanecarboxylate,
4-(4-n-propylcyclohexyl)-phenyl 4-ethylcyclohexanecarboxylate,
4-(4-n-butylcyclohexyl)-phenyl 4-ethylcyclohexanecarboxylate,
4-(4-n-pentylcyclohexyl)-phenyl 4-ethylcyclohexanecarboxylate,
4-(4-n-hexylcyclohexyl)-phenyl 4-ethylcyclohexanecarboxylate,
15 4-(4-n-heptylcyclohexyl)-phenyl 4-ethylcyclohexanecarboxylate,
4-(4-methylcyclohexyl)-phenyl 4-n-propylcyclohexanecarboxylate,
4-(4-ethylcyclohexyl)-phenyl 4-n-propylcyclohexanecarboxylate,
4-(4-n-propylcyclohexyl)-phenyl 4-n-propylcyclohexanecarboxylate
m.p. 110°C, Cl. 190°C;
20 4-(4-n-butylcyclohexyl)-phenyl 4-n-propylcyclohexanecarboxylate,
m.p. 117°C, Cl. 185°C;
4-(4-n-pentylcyclohexyl)-phenyl 4-n-propylcyclohexanecarboxylate,
4-(4-n-hexylcyclohexyl)-phenyl 4-n-propylcyclohexanecarboxylate,
4-(4-n-heptylcyclohexyl)-phenyl 4-n-propylcyclohexanecarboxylate,
25 4-(4-methylcyclohexyl)-phenyl 4-n-butylcyclohexanecarboxylate,
4-(4-ethylcyclohexyl)-phenyl 4-n-butylcyclohexanecarboxylate,
4-(4-n-propylcyclohexyl)-phenyl 4-n-butylcyclohexanecarboxylate,
4-(4-n-butylcyclohexyl)-phenyl 4-n-butylcyclohexanecarboxylate,
4-(4-n-hexylcyclohexyl)-phenyl 4-n-butylcyclohexanecarboxylate,

- 4-(4-n-heptylcyclohexyl)-phenyl 4-n-butylcyclohexanecarboxylate,
4-(4-methylcyclohexyl)-phenyl 4-n-pentylcyclohexanecarboxylate,
4-(4-ethylcyclohexyl)-phenyl 4-n-pentylcyclohexanecarboxylate,
4-(4-n-propylcyclohexyl)-phenyl 4-n-pentylcyclohexanecarboxylate,
5 m.p. 42°C, S./N. 128°C, Cl. 187°C;
4-(4-n-butylcyclohexyl)-phenyl 4-n-pentylcyclohexanecarboxylate,
4-(4-n-pentylcyclohexyl)-phenyl 4-n-pentylcyclohexanecarboxylate,
4-(4-n-hexylcyclohexyl)-phenyl 4-n-pentylcyclohexanecarboxylate,
4-(4-n-heptylcyclohexyl)-phenyl 4-n-pentylcyclohexanecarboxylate,
10 m.p. 32°C, Cl. 180°C;
4-(4-methylcyclohexyl)-phenyl 4-n-hexylcyclohexanecarboxylate,
4-(4-ethylcyclohexyl)-phenyl 4-n-hexylcyclohexanecarboxylate,
4-(4-n-propylcyclohexyl)-phenyl 4-n-hexylcyclohexanecarboxylate,
4-(4-n-butylcyclohexyl)-phenyl 4-n-hexylcyclohexanecarboxylate,
15 4-(4-n-pentylcyclohexyl)-phenyl 4-n-hexylcyclohexanecarboxylate,
4-(4-n-hexylcyclohexyl)-phenyl 4-n-hexylcyclohexanecarboxylate,
4-(4-n-heptylcyclohexyl)-phenyl 4-n-hexylcyclohexanecarboxylate,
4-(4-methylcyclohexyl)-phenyl 4-n-heptylcyclohexanecarboxylate,
4-(4-ethylcyclohexyl)-phenyl 4-n-heptylcyclohexanecarboxylate,
20 4-(4-n-propylcyclohexyl)-phenyl 4-n-heptylcyclohexanecarboxylate,
4-(4-n-butylcyclohexyl)-phenyl 4-n-heptylcyclohexanecarboxylate,
4-(4-n-pentylcyclohexyl)-phenyl 4-n-heptylcyclohexanecarboxylate,
4-(4-n-hexylcyclohexyl)-phenyl 4-n-heptylcyclohexanecarboxylate,
4-(4-n-heptylcyclohexyl)-phenyl 4-n-heptylcyclohexanecarboxylate,

25 Example 2

16.5 g of 4-n-propylbenzoic acid and 24.7 g of 4-(4-n-pentylcyclohexyl)-phenol are heated to the boil under reflux with 0.25 g of concentrated sulphuric acid and 0.15 g of boric acid in 250 ml of toluene for 24 hours in a round-bottomed flask provided with a water separator; about

0.8 ml of water is separated off azeotropically. The reaction mixture is washed three times with, in each case, 200 ml of water, once with 200 ml of 5% aqueous sodium bicarbonate solution and a further twice with, in each case, 5 200 ml of water and dried over sodium sulphate. After distilling off the toluene, the resulting 4'-(4-n-pentylcyclohexyl)-phenyl 4-n-propylbenzoate is recrystallised from methanol.

The following compounds are prepared analogously:

- 10 4'-(4-methylcyclohexyl)-phenyl 4-methylbenzoate,
4'-(4-ethylcyclohexyl)-phenyl 4-methylbenzoate,
4'-(4-n-propylcyclohexyl)-phenyl 4-methylbenzoate,
4'-(4-n-butylcyclohexyl)-phenyl 4-methylbenzoate,
4'-(4-n-pentylcyclohexyl)-phenyl 4-methylbenzoate,
- 15 4'-(4-n-hexylcyclohexyl)-phenyl 4-methylbenzoate,
4'-(4-n-heptylcyclohexyl)-phenyl 4-methylbenzoate,
4'-(4-n-octylcyclohexyl)-phenyl 4-methylbenzoate,
4'-[4-(2-methylbutyl)-cyclohexyl]-phenyl 4-methylbenzoate,
4'-(4-methylcyclohexyl)-phenyl 4-ethylbenzoate,
- 20 4'-(4-ethylcyclohexyl)-phenyl 4-ethylbenzoate,
4'-(4-n-propylcyclohexyl)-phenyl 4-ethylbenzoate,
4'-(4-n-butylcyclohexyl)-phenyl 4-ethylbenzoate,
4'-(4-n-pentylcyclohexyl)-phenyl 4-ethylbenzoate,
4'-(4-n-hexylcyclohexyl)-phenyl 4-ethylbenzoate,
- 25 4'-(4-n-heptylcyclohexyl)-phenyl 4-ethylbenzoate,
4'-(4-n-octylcyclohexyl)-phenyl 4-ethylbenzoate,
4'-[4-(2-methylbutyl)-cyclohexyl]-phenyl 4-ethylbenzoate,
4'-(4-methylcyclohexyl)-phenyl 4-n-propylbenzoate,
4'-(4-ethylcyclohexyl)-phenyl 4-n-propylbenzoate,

- 4'-(4-n-propylcyclohexyl)-phenyl 4-n-propylbenzoate,
4'-(4-n-butylcyclohexyl)-phenyl 4-n-propylbenzoate,
4'-(4-n-hexylcyclohexyl)-phenyl 4-n-propylbenzoate,
4'-(4-n-heptylcyclohexyl)-phenyl 4-n-propylbenzoate,
5 4'-(4-n-octylcyclohexyl)-phenyl 4-n-propylbenzoate,
4'-[4-(2-methylbutyl)-cyclohexyl]-phenyl 4-n-propylbenzoate,
4'-(4-methylcyclohexyl)-phenyl 4-n-butylbenzoate,
4'-(4-ethylcyclohexyl)-phenyl 4-n-butylbenzoate,
4'-(4-n-propylcyclohexyl)-phenyl 4-n-butylbenzoate,
10 4'-(4-n-butylcyclohexyl)-phenyl 4-n-butylbenzoate,
4'-(4-n-pentylcyclohexyl)-phenyl 4-n-butylbenzoate,
4'-(4-n-hexylcyclohexyl)-phenyl 4-n-butylbenzoate,
4'-(4-n-heptylcyclohexyl)-phenyl 4-n-butylbenzoate,
4'-(4-n-octylcyclohexyl)-phenyl 4-n-butylbenzoate,
15 4'-[4-(2-methylbutyl)-cyclohexyl]-phenyl 4-n-butylbenzoate,
4'-(4-methylcyclohexyl)-phenyl 4-n-pentylbenzoate,
4'-(4-ethylcyclohexyl)-phenyl 4-n-pentylbenzoate,
4'-(4-n-propylcyclohexyl)-phenyl 4-n-pentylbenzoate,
m.p. 98°C, Cl. 180°C;
20 4'-(4-n-butylcyclohexyl)-phenyl 4-n-pentylbenzoate,
m.p. 96°C, Cl. 171°C;
4'-(4-n-pentylcyclohexyl)-phenyl 4-n-pentylbenzoate,
4'-(4-n-hexylcyclohexyl)-phenyl 4-n-pentylbenzoate,
4'-(4-n-heptylcyclohexyl)-phenyl 4-n-pentylbenzoate,
25 m.p. 78°C, S./N. 104°C, Cl. 165°C;
4'-(4-n-octylcyclohexyl)-phenyl 4-n-pentylbenzoate,
4'-[4-(2-methylbutyl)-cyclohexyl]-phenyl 4-n-pentylbenzoate,
4'-(4-methylcyclohexyl)-phenyl 4-n-hexylbenzoate,
4'-(4-ethylcyclohexyl)-phenyl 4-n-hexylbenzoate,

- 4'-(4-n-propylcyclohexyl)-phenyl 4-n-hexylbenzoate,
4'-(4-n-butylcyclohexyl)-phenyl 4-n-hexylbenzoate,
4'-(4-n-pentylcyclohexyl)-phenyl 4-n-hexylbenzoate,
4'-(4-n-hexylcyclohexyl)-phenyl 4-n-hexylbenzoate,
5 4'-(4-n-heptylcyclohexyl)-phenyl 4-n-hexylbenzoate,
4'-(4-n-octylcyclohexyl)-phenyl 4-n-hexylbenzoate,
4'-[4-(2-methylbutyl)-cyclohexyl]-phenyl 4-n-hexylbenzoate,
4'-(4-methylcyclohexyl)-phenyl 4-n-heptylbenzoate,
4'-(4-ethylcyclohexyl)-phenyl 4-n-heptylbenzoate,
10 4'-(4-n-propylcyclohexyl)-phenyl 4-n-heptylbenzoate,
4'-(4-n-butylcyclohexyl)-phenyl 4-n-heptylbenzoate,
4'-(4-n-pentylcyclohexyl)-phenyl 4-n-heptylbenzoate,
4'-(4-n-hexylcyclohexyl)-phenyl 4-n-heptylbenzoate,
4'-(4-n-heptylcyclohexyl)-phenyl 4-n-heptylbenzoate,
15 4'-(4-n-octylcyclohexyl)-phenyl 4-n-heptylbenzoate,
4'-[4-(2-methylbutyl)-cyclohexyl]-phenyl-4-n-heptylbenzoate,
4'-(4-methylcyclohexyl)-phenyl 4-n-octylbenzoate,
4'-(4-ethylcyclohexyl)-phenyl 4-n-octylbenzoate,
4'-(4-n-propylcyclohexyl)-phenyl 4-n-octylbenzoate,
20 4'-(4-n-butylcyclohexyl)-phenyl 4-n-octylbenzoate,
4'-(4-n-pentylcyclohexyl)-phenyl 4-n-octylbenzoate,
4'-(4-n-hexylcyclohexyl)-phenyl 4-n-octylbenzoate,
4'-(4-n-heptylcyclohexyl)-phenyl 4-n-octylbenzoate,
4'-(4-n-octylcyclohexyl)-phenyl 4-n-octylbenzoate,
25 4'-[4-(2-methylbutyl)-cyclohexyl]-phenyl 4-n-octylbenzoate,
4'-(4-methylcyclohexyl)-phenyl 4-(1-methylbutyl)-benzoate,
4'-(4-ethylcyclohexyl)-phenyl 4-(1-methylbutyl)-benzoate,
4'-(4-n-propylcyclohexyl)-phenyl 4-(1-methylbutyl)-benzoate,
4'-(4-n-butylcyclohexyl)-phenyl 4-(1-methylbutyl)-benzoate,

- 4'-(4-n-pentylcyclohexyl)-phenyl 4-(1-methylbutyl)-benzoate,
4'-(4-n-hexylcyclohexyl)-phenyl 4-(1-methylbutyl)-benzoate,
4'-(4-n-heptylcyclohexyl)-phenyl 4-(1-methylbutyl)-benzoate,
4'-(4-n-octylcyclohexyl)-phenyl 4-(1-methylbutyl)-benzoate,
5 4'-methylphenyl 4-(4-methylcyclohexyl)-cyclohexane-
carboxylate,
4'-ethylphenyl 4-(4-methylcyclohexyl)-cyclohexane-
carboxylate,
4'-n-propylphenyl 4-(4-methylcyclohexyl)-cyclohexane-
10 carboxylate,
4'-n-butylphenyl 4-(4-methylcyclohexyl)-cyclohexane-
carboxylate,
4'-n-pentylphenyl 4-(4-methylcyclohexyl)-cyclohexane-
carboxylate,
15 4'-n-hexylphenyl 4-(4-methylcyclohexyl)-cyclohexane-
carboxylate,
4'-n-heptylphenyl 4-(4-methylcyclohexyl)-cyclohexane-
carboxylate,
4'-n-octylphenyl 4-(4-methylcyclohexyl)-cyclohexane-
20 carboxylate,
4'-(2-methylbutyl)-phenyl 4-(4-methylcyclohexyl)-cyclo-
hexanecarboxylate,
4'-cyanophenyl 4-(4-methylcyclohexyl)-cyclohexanecarboxylate,
4'-methoxyphenyl 4-(4-methylcyclohexyl)-cyclohexane-
25 carboxylate,
4'-ethoxyphenyl 4-(4-methylcyclohexyl)-cyclohexane-
carboxylate,
4'-n-propoxyphenyl 4-(4-methylcyclohexyl)-cyclohexane-
carboxylate,

- 4'-n-butoxyphenyl 4-(4-methylcyclohexyl)-cyclohexane-carboxylate,
- 4'-n-pentyloxyphenyl 4-(4-methylcyclohexyl)-cyclohexane-carboxylate,
- 5 4'-n-hexyloxyphenyl 4-(4-methylcyclohexyl)-cyclohexane-carboxylate,
- 4'-acetoxypheyl 4-(4-methylcyclohexyl)-cyclohexane-carboxylate,
- 4'-propionyloxyphenyl 4-(4-methylcyclohexyl)-cyclohexane-
- 10 carboxylate,
- 4'-n-butanoyloxyphenyl 4-(4-methylcyclohexyl)-cyclohexane-carboxylate,
- 4'-n-pentanoyloxyphenyl 4-(4-methylcyclohexyl)-cyclohexane-carboxylate,
- 15 4'-n-hexanoyloxyphenyl 4-(4-methylcyclohexyl)-cyclohexane-carboxylate,
- 4'-n-heptanoyloxyphenyl 4-(4-methylcyclohexyl)-cyclohexane-carboxylate,
- 4'-methylphenyl 4-(4-ethylcyclohexyl)-cyclohexanecarboxylate,
- 20 4'-ethylphenyl 4-(4-ethylcyclohexyl)-cyclohexanecarboxylate,
- 4'-n-propylphenyl 4-(4-ethylcyclohexyl)-cyclohexane-carboxylate,
- 4'-n-butylphenyl 4-(4-ethylcyclohexyl)-cyclohexane-carboxylate,
- 25 4'-n-pentylphenyl 4-(4-ethylcyclohexyl)-cyclohexane-carboxylate,
- 4'-n-hexylphenyl 4-(4-ethylcyclohexyl)-cyclohexane-carboxylate,
- 4'-n-heptylphenyl 4-(4-ethylcyclohexyl)-cyclohexane-

- carboxylate,
- 4'-(2-methylbutyl)-phenyl-4-(4-ethylcyclohexyl)-cyclohexane-
carboxylate,
- 4'-cyanophenyl 4-(4-ethylcyclohexyl)-cyclohexanecarboxylate,
- 5 4'-methoxyphenyl 4-(4-ethylcyclohexyl)-cyclohexane-
carboxylate,
- 4'-ethoxyphenyl 4-(4-ethylcyclohexyl)-cyclohexane-
carboxylate,
- 4'-n-propoxyphenyl 4-(4-ethylcyclohexyl)-cyclohexane-
- 10 carboxylate
- 4'-n-butoxyphenyl 4-(4-ethylcyclohexyl)-cyclohexane-
carboxylate,
- 4'-n-pentyloxyphenyl 4-(4-ethylcyclohexyl)-cyclohexane-
carboxylate,
- 15 4'-n-hexyloxyphenyl 4-(4-ethylcyclohexyl)-cyclohexane-
carboxylate,
- 4'-acetoxypheyl 4-(4-ethylcyclohexyl)-cyclohexane-
carboxylate,
- 4'-propionyloxyphenyl 4-(4-ethylcyclohexyl)-cyclohexane-
- 20 carboxylate,
- 4'-n-butanoyloxyphenyl 4-(4-ethylcyclohexyl)-cyclohexane-
carboxylate,
- 4'-n-pentanoyloxyphenyl 4-(4-ethylcyclohexyl)-cyclohexane-
carboxylate,
- 25 4'-n-hexanoyloxyphenyl 4-(4-ethylcyclohexyl)-cyclohexane-
carboxylate
- 4'-n-heptanoyloxyphenyl 4-(4-ethylcyclohexyl)-cyclohexane-
carboxylate,
- 4'-methylphenyl 4-(4-n-propylcyclohexyl)-cyclohexane-

- carboxylate,
4'-ethylphenyl 4-(4-n-propylcyclohexyl)-cyclohexane-
carboxylate,
4'-n-propylphenyl 4-(4-n-propylcyclohexyl)-cyclohexane-
5 carboxylate, m.p. 60°C, S./N. 152°C, Cl. 203°C;
4'-n-butylphenyl 4-(4-n-propylcyclohexyl)-cyclohexane-
carboxylate,
4'-n-pentylphenyl 4-(4-n-propylcyclohexyl)-cyclohexane-
carboxylate, m.p. 34°C, S./N. 159°C, Cl. 192°C;
10 4'-n-hexylphenyl 4-(4-n-propylcyclohexyl)-cyclohexane-
carboxylate,
4'-n-heptylphenyl 4-(4-n-propylcyclohexyl)-cyclohexane-
carboxylate,
4'-(2-methylbutyl)-phenyl 4-(4-n-propylcyclohexyl)-cyclo-
15 hexanecarboxylate,
4'-cyanophenyl 4-(4-n-propylcyclohexyl)-cyclohexanecarboxy-
late, m.p. 93°, Cl. 210°C
4'-methoxyphenyl 4-(4-n-propylcyclohexyl)-cyclohexane-
carboxylate,
20 4'-ethoxyphenyl 4-(4-n-propylcyclohexyl)-cyclohexane-
carboxylate,
4'-n-propoxyphenyl 4-(4-n-propylcyclohexyl)-cyclohexane-
carboxylate,
4'-n-butoxyphenyl 4-(4-n-propylcyclohexyl)-cyclohexane-
25 carboxylate,
4'-n-pentyloxyphenyl 4-(4-n-propylcyclohexyl)-cyclohexane-
carboxylate,
4'-n-hexyloxyphenyl 4-(4-n-propylcyclohexyl)-cyclohexane-
carboxylate,

- 4'-acetoxyphenyl 4-(4-n-propylcyclohexyl)-cyclohexane-carboxylate,
- 4'-propionyloxyphenyl 4-(4-n-propylcyclohexyl)-cyclohexane-carboxylate,
- 5 4'-n-butanoyloxyphenyl 4-(4-n-propylcyclohexyl)-cyclohexane-carboxylate,
- 4'-n-pentanoyloxyphenyl 4-(4-n-propylcyclohexyl)-cyclohexanecarboxylate,
- 4'-n-hexanoyloxyphenyl 4-(4-n-propylcyclohexyl)-cyclo-
- 10 hexanecarboxylate,
- 4'-n-heptanoyloxyphenyl 4-(4-n-propylcyclohexyl)-cyclohexanecarboxylate,
- 4'-methylphenyl 4-(4-n-butylcyclohexyl)-cyclohexane-carboxylate,
- 15 4'-ethylphenyl 4-(4-n-butylcyclohexyl)-cyclohexane-carboxylate,
- 4'-n-propylphenyl 4-(4-n-butylcyclohexyl)-cyclohexane-carboxylate,
- 4'-n-butylphenyl 4-(4-n-butylcyclohexyl)-cyclohexane-
- 20 carboxylate,
- 4'-n-pentylphenyl 4-(4-n-butylcyclohexyl)-cyclohexane-carboxylate,
- 4'-n-hexylphenyl 4-(4-n-butylcyclohexyl)-cyclohexane-carboxylate,
- 25 4'-n-heptylphenyl 4-(4-n-butylcyclohexyl)-cyclohexane-carboxylate,
- 4'-(2-methylbutyl)-phenyl 4-(4-n-butylcyclohexyl)-cyclohexanecarboxylate,
- 4'-cyanophenyl 4-(4-n-butylcyclohexyl)-cyclohexane-

- carboxylate,
4'-methoxyphenyl 4-(4-n-butylcyclohexyl)-cyclohexane-
carboxylate,
4'-ethoxyphenyl 4-(4-n-butylcyclohexyl)-cyclohexane-
5 carboxylate,
4'-n-propoxyphenyl 4-(4-n-butylcyclohexyl)-cyclohexane-
carboxylate,
4'-n-butoxyphenyl 4-(4-n-butylcyclohexyl)-cyclohexane-
carboxylate,
10 4'-n-pentyloxyphenyl 4-(4-n-butylcyclohexyl)-cyclohexane-
carboxylate,
4'-n-hexyloxyphenyl 4-(4-n-butylcyclohexyl)-cyclohexane-
carboxylate,
4'-acetoxypheyl 4-(4-n-butylcyclohexyl)-cyclohexane-
15 carboxylate,
4'-propionyloxyphenyl 4-(4-n-butylcyclohexyl)-cyclohexane-
carboxylate,
4'-n-butanoyloxyphenyl 4-(4-n-butylcyclohexyl)-cyclo-
hexanecarboxylate,
20 4'-n-pentanoyloxyphenyl 4-(4-n-butylcyclohexyl)-cyclo-
hexanecarboxylate,
4'-n-hexanoyloxyphenyl 4-(4-n-butylcyclohexyl)-cyclohexane-
carboxylate,
4'-methylphenyl 4-(4-n-pentylcyclohexyl)-cyclohexane-
25 carboxylate,
4'-ethylphenyl 4-(4-n-pentylcyclohexyl)-cyclohexane-
carboxylate,
4'-n-propylphenyl 4-(4-n-pentylcyclohexyl)-cyclohexane
carboxylate,

- 4'-n-butylphenyl 4-(4-n-pentylcyclohexyl)-cyclohexane-carboxylate,
- 4'-n-pentylphenyl 4-(4-n-pentylcyclohexyl)-cyclohexane-carboxylate,
- 5 4'-n-hexylphenyl 4-(4-n-pentylcyclohexyl)-cyclohexane-carboxylate,
- 4'-n-heptylphenyl 4-(4-n-pentylcyclohexyl)-cyclohexane-carboxylate,
- 4'-(2-methylbutyl)-phenyl 4-(4-n-pentylcyclohexyl)-cyclo-
- 10 hexanecarboxylate,
- 4'-cyanophenyl 4-(4-n-pentylcyclohexyl)-cyclohexane-carboxylate, m.p. 92°, Cl. 232° C;
- 4'-methoxyphenyl 4-(4-n-pentylcyclohexyl)-cyclohexane-carboxylate,
- 15 4'-ethoxyphenyl 4-(4-n-pentylcyclohexyl)-cyclohexane-carboxylate,
- 4'-n-propoxyphenyl 4-(4-n-pentylcyclohexyl)-cyclohexane-carboxylate,
- 4'-n-butoxyphenyl 4-(4-n-pentylcyclohexyl)-cyclohexane-
- 20 carboxylate,
- 4'-n-pentyloxyphenyl 4-(4-n-pentylcyclohexyl)-cyclohexane-carboxylate,
- 4'-n-hexyloxyphenyl 4-(4-n-pentylcyclohexyl)-cyclohexane-carboxylate,
- 25 4'-acetoxyphenyl 4-(4-n-pentylcyclohexyl)-cyclohexane-carboxylate,
- 4'-propionyloxyphenyl 4-(4-n-pentylcyclohexyl)-cyclohexane-carboxylate,
- 4'-n-butanoyloxyphenyl 4-(4-n-pentylcyclohexyl)-cyclo-

- hexanecarboxylate,
4'-n-pentanoyloxyphenyl 4-(4-n-pentylcyclohexyl)-cyclo-
hexanecarboxylate,
4'-n-hexanoyloxyphenyl 4-(4-n-pentylcyclohexyl)-cyclo-
5 hexanecarboxylate,
4'-methylphenyl 4-(4-n-hexylcyclohexyl)-cyclohexane-
carboxylate,
4'-ethylphenyl 4-(4-n-hexylcyclohexyl)-cyclohexane-
carboxylate,
10 4'-n-propylphenyl 4-(4-n-hexylcyclohexyl)-cyclohexane-
carboxylate,
4'-n-butylphenyl 4-(4-n-hexylcyclohexyl)-cyclohexane-
carboxylate,
4'-n-pentylphenyl 4-(4-n-hexylcyclohexyl)-cyclohexane-
15 carboxylate,
4'-n-hexylphenyl 4-(4-n-hexylcyclohexyl)-cyclohexane-
carboxylate,
4'-(2-methylbutyl)-phenyl 4-(4-n-hexylcyclohexyl)-cyclo-
hexanecarboxylate,
20 4'-cyanophenyl 4-(4-n-hexylcyclohexyl)-cyclohexane-
carboxylate,
4'-methoxyphenyl 4-(4-n-hexylcyclohexyl)-cyclohexane-
carboxylate,
4'-ethoxyphenyl 4-(4-n-hexylcyclohexyl)-cyclohexane-
25 carboxylate,
4'-n-propoxyphenyl 4-(4-n-hexylcyclohexyl)-cyclohexane-
carboxylate,
4'-n-butoxyphenyl 4-(4-n-hexylcyclohexyl)-cyclohexane-
carboxylate,

- 4'-acetoxyphenyl 4-(4-n-hexylcyclohexyl)-cyclohexane-carboxylate,
- 4'-propionyloxyphenyl 4-(4-n-hexylcyclohexyl)-cyclohexane-carboxylate,
- 5 4'-n-butanoyloxyphenyl 4-(4-n-hexylcyclohexyl)-cyclohexane-carboxylate,
- 4'-n-pentanoyloxyphenyl 4-(4-n-hexylcyclohexyl)-cyclohexane-carboxylate,
- 4'-methylphenyl 4-(4-n-heptylcyclohexyl)-cyclohexane-
- 10 carboxylate,
- 4'-ethylphenyl 4-(4-n-heptylcyclohexyl)-cyclohexane-carboxylate,
- 4'-n-propylphenyl 4-(4-n-heptylcyclohexyl)-cyclohexane-carboxylate,
- 15 4'-n-butylphenyl 4-(4-n-heptylcyclohexyl)-cyclohexane-carboxylate,
- 4'-n-pentylphenyl 4-(4-n-heptylcyclohexyl)-cyclohexane-carboxylate,
- 4'-(2-methylbutyl)-phenyl 4-(4-n-heptylcyclohexyl)-cyclo-
- 20 hexanecarboxylate,
- 4'-cyanophenyl 4-(4-n-heptylcyclohexyl)-cyclohexane-carboxylate, m.p. 90°, S./N. 118°, Cl. 222° C;
- 4'-methoxyphenyl 4-(4-n-heptylcyclohexyl)-cyclohexane-carboxylate,
- 25 4'-ethoxyphenyl 4-(4-n-heptylcyclohexyl)-cyclohexane-carboxylate,
- 4'-n-propoxyphenyl 4-(4-n-heptylcyclohexyl)-cyclohexane-carboxylate,
- 4'-n-butoxyphenyl 4-(4-n-heptylcyclohexyl)-cyclohexane-

- carboxylate,
4'-acetoxyphenyl 4-(4-n-heptylcyclohexyl)-cyclohexane-
carboxylate,
4'-propionyloxyphenyl 4-(4-n-heptylcyclohexyl)-cyclohexane-
5 carboxylate,
4'-n-butanoyloxyphenyl 4-(4-n-heptylcyclohexyl)-cyclo-
hexanecarboxylate,
4'-n-pentanoyloxyphenyl 4-(4-n-heptylcyclohexyl)-cyclo-
hexanecarboxylate,
10 4'-methylphenyl 4-(4-n-octylcyclohexyl)-cyclohexane-
carboxylate,
4'-ethylphenyl 4-(4-n-octylcyclohexyl)-cyclohexane-
carboxylate,
4'-n-propylphenyl 4-(4-n-octylcyclohexyl)-cyclohexane-
15 carboxylate,
4'-n-butylphenyl 4-(4-n-octylcyclohexyl)-cyclohexane-
carboxylate,
4'-(2-methylbutyl)-phenyl 4-(4-n-octylcyclohexyl)-cyclo-
hexanecarboxylate,
20 4'-cyanophenyl 4-(4-n-octylcyclohexyl)-cyclohexanecarboxy-
late,
4'-methoxyphenyl 4-(4-n-octylcyclohexyl)-cyclohexane-
carboxylate,
4'-ethoxyphenyl 4-(4-n-octylcyclohexyl)-cyclohexane-
25 carboxylate,
4'-n-propoxyphenyl 4-(4-n-octylcyclohexyl)-cyclohexane-
carboxylate,
4'-n-butoxyphenyl 4-(4-n-octylcyclohexyl)-cyclohexane-
carboxylate,

- 4'-acetoxyphenyl 4-(4-n-octylcyclohexyl)-cyclohexane-carboxylate,
- 4'-propionyloxyphenyl 4-(4-n-octylcyclohexyl)-cyclohexane-carboxylate,
- 5 4'-n-butanoyloxyphenyl 4-(4-n-octylcyclohexyl)-cyclohexanecarboxylate,
- 4'-methylphenyl 4-[4-(2-methylbutyl)-cyclohexyl]-cyclohexanecarboxylate,
- 4'-ethylphenyl 4-[4-(2-methylbutyl)-cyclohexyl]-cyclo-
- 10 hexanecarboxylate,
- 4'-n-propylphenyl 4-[4-(2-methylbutyl)-cyclohexyl]-cyclohexanecarboxylate,
- 4'-n-butylphenyl 4-[4-(2-methylbutyl)-cyclohexyl]-cyclohexanecarboxylate,
- 15 4'-n-pentylphenyl 4-[4-(2-methylbutyl)-cyclohexyl]-cyclohexanecarboxylate,
- 4'-n-hexylphenyl 4-[4-(2-methylbutyl)-cyclohexyl]-cyclohexanecarboxylate,
- 4'-n-heptylphenyl 4-[4-(2-methylbutyl)-cyclohexyl]-cyclo-
- 20 hexanecarboxylate,
- 4'-n-octylphenyl 4-[4-(2-methylbutyl)-cyclohexyl]-cyclohexanecarboxylate,
- 4'-cyanophenyl 4-[4-(2-methylbutyl)-cyclohexyl]-cyclohexanecarboxylate,
- 25 4'-methoxyphenyl 4-[4-(2-methylbutyl)-cyclohexyl]-cyclohexanecarboxylate,
- 4'-ethoxyphenyl 4-[4-(2-methylbutyl)-cyclohexyl]-cyclohexanecarboxylate,
- 4'-n-propoxyphenyl 4-[4-(2-methylbutyl)-cyclohexyl]-cyclo-

- hexanecarboxylate,
4'-n-butoxyphenyl 4-[4-(2-methylbutyl)-cyclohexyl]-cyclo-
hexanecarboxylate,
4'-n-pentyloxyphenyl 4-[4-(2-methylbutyl)-cyclohexyl]-cyclo-
5 hexanecarboxylate,
4'-n-hexyloxyphenyl 4-[4-(2-methylbutyl)-cyclohexyl]-cyclo-
hexanecarboxylate,
4'-acetoxyphenyl 4-[4-(2-methylbutyl)-cyclohexyl]-cyclo-
hexanecarboxylate,
10 4'-propionyloxyphenyl 4-[4-(2-methylbutyl)-cyclohexyl]-
cyclohexanecarboxylate,
4'-n-butanoyloxyphenyl 4-[4-(2-methylbutyl)-cyclohexyl]-
cyclohexanecarboxylate,
4'-n-pentanoyloxyphenyl 4-[4-(2-methylbutyl)-cyclohexyl]-
15 cyclohexanecarboxylate,
4'-n-hexanoyloxyphenyl 4-[4-(2-methylbutyl)-cyclohexyl]-
cyclohexanecarboxylate and
4'-n-heptanoyloxyphenyl 4-[4-(2-methylbutyl)-cyclohexyl]-
cyclohexanecarboxylate.

20 The examples which follow relate to liquid crystal dielectrics according to the invention:

Example 3

A mixture of 55% of 4'-n-propylphenyl 4-n-hexanoyloxybenzoate and 45% of 4'-n-heptylphenyl 4-n-hexanoyloxy-
25 benzoate has a m.p. of 20° and a Cl. of 56°. A dielectric of 94% of this base mixture and 6% of 4'-cyanophenyl 4-(4-n-pentylcyclohexyl)-cyclohexane-1-carboxylate, according to the invention, has a m.p. below 20° (a precise measurement is very difficult because supercooling phenomena arise) and

Cl. of 66.5° .

Example 4

4-n-Pentyl-4'-cyanobiphenyl has a m.p. of 22.5° and a Cl. of 35° . On the addition of 10% (based on the total weight of the mixture) of 4'-n-heptylcyclohexyl 4-(4-n-hexylcyclohexyl)-benzoate according to the invention the m.p. falls to 22° whilst the Cl. rises to 44.5° .

Example 5

A mixture of 67% of 4-n-pentylphenyl anisate and 33% of 4'-n-pentylphenyl 4-n-hexyloxybenzoate has a m.p. of 16° and a Cl. of 49° . A dielectric of 90% of this base mixture and 10% of 4'-n-pentylphenyl 4-(4-n-heptylcyclohexyl)-benzoate according to the invention has a m.p. of about 10° and a Cl. of 61° .

Example 6

4-(4-n-Heptylcyclohexyl)-benzonitrile has a m.p. of 30° and a Cl. of 57° . On the addition of 20% of 4'-cyanophenyl 4-(4-n-heptylcyclohexyl)-benzoate according to the invention, the melting point is virtually unchanged whilst the clear point rises to 79° .

Example 7

A mixture of equal parts by weight of 4-n-pentyl-4'-cyanobiphenyl and 4-n-heptyl-4'-cyanobiphenyl has a Cl. of 38.5° . On the addition of 10% of 4'-n-pentylphenyl 4-(4-n-heptylcyclohexyl)-benzoate according to the invention the Cl. is raised to 47° .

Example 8

A mixture of 19% of 4-(4-n-propylcyclohexyl)-benzonitrile, 28% of 4-(4-n-pentylcyclohexyl)-benzonitrile,

20% of 4-(4-n-heptylcyclohexyl)-benzonitrile, 12% of 4-(4-n-pentylcyclohexyl)-4'-cyanobiphenyl, 11% of 4'-n-propylphenyl 4-(4-n-propylcyclohexyl)-benzoate and 10% of 4'-n-propylcyclohexyl 4-(4-n-propylcyclohexyl)-benzoate has the
5 exceptionally broad nematic range from -10° to $+86^{\circ}$ and a viscosity of 36 cP.

Example 9

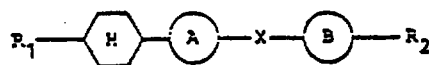
A mixture of 24% of 4-(4-n-propylcyclohexyl)-benzonitrile, 35% of 4-(4-n-pentylcyclohexyl)-benzonitrile,
10 13% of 4'-n-propylphenyl 4-(4-n-propylcyclohexyl)-benzoate, 12% of 4'-n-propylcyclohexyl 4-(4-n-propylcyclohexyl)-benzoate and 16% of 4'-n-propylcyclohexyl 4-(4-n-pentylcyclohexyl)-benzoate has a nematic range from -5° to $+86^{\circ}$ and a viscosity of 42 cP and the temperature dependence of
15 the threshold voltage is very low.



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Patent Claims

1. Cyclohexane derivatives of the general formula (I)



in which the rings A and B are identical or different and are each a 1,4-disubstituted phenyl or cyclohexyl ring and X is -CO-O- or -O-CO-, R₁ is alkyl with 1 to 8 carbon atoms and R₂ is alkyl with 1 to 8 carbon atoms, and if the ring B is a phenyl ring R₂ is also alkoxy or alkanoyloxy with up to 8 carbon atoms or -CN.

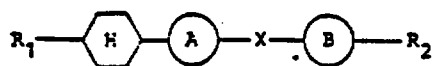
2. Cyclohexane derivatives according to Claim 1, in which X is CO-O-.

3. Cyclohexane derivatives according to one of Claims 1 or 2, in which R₁ is straight-chain alkyl with 1 to 6 carbon atoms.

4. Cyclohexane derivatives according to one of Claims 1 to 3, in which R₂ is straight-chain alkyl with 1 to 6 carbon atoms.

5. Cyclohexane derivatives according to Claim 1, in which R₂ is -CN.

6. Dielectric for liquid crystal display elements with at least two liquid crystal components, characterised in that at least one of these components is a cyclohexane derivative of the general formula (I)



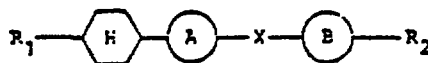
in which the rings A and B are identical or different and are each a 1,4-disubstituted phenyl or cyclohexyl ring and X is -CO-O- or -O-CO-, R₁ is alkyl with 1 to 8 carbon atoms



and R_2 is alkyl with 1 to 8 carbon atoms, and if the ring B is a phenyl ring R_2 is also alkoxy or alkanoyloxy with up to 8 carbon atoms or -CN.

7. Dielectric according to Claim 6, characterised in that it contains 1 to 40 per cent by weight of one or more cyclohexane derivatives of the general formula (I).

8. Use of a cyclohexane derivative of the general formula (I)

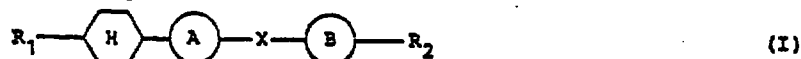


in which the rings A and B are identical or different and are each a 1,4-disubstituted phenyl or cyclohexyl ring and X is -CO-O- or -O-CO-, R_1 is alkyl with 1 to 8 carbon atoms and R_2 is alkyl with 1 to 8 carbon atoms, and if the ring B is a phenyl ring R_2 is also alkoxy or alkanoyloxy with up to 8 carbon atoms or -CN, as a component of a dielectric for liquid crystal display elements.



Claims

1. Cyclohexane derivatives of the general formula (I)



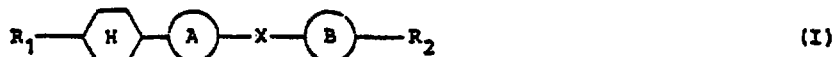
in which the rings A and B are identical or different and are each a 1,4-disubstituted phenyl or cyclohexyl ring and X is —CO—O— or —O—CO—, R₁ is alkyl with 1—8 carbon atoms and R₂ is alkyl with 1—8 carbon atoms, and if the ring B is a phenyl ring R₂ is also alkoxy or alkanoyloxy with up to 8 carbon atoms or —CN.

2. Cyclohexane derivatives according to Claim 1, in which X is CO—O—.
3. Cyclohexane derivatives according to one of Claims 1—2, in which R₁ is straight-chain alkyl with 1—6 carbon atoms.
4. Cyclohexane derivatives according to one of Claims 1—3, in which R₂ is straight-chain alkyl with 1—6 carbon atoms.
5. Cyclohexane derivatives according to Claim 1, in which R₂ is —CN.
6. Dielectric for liquid crystal display elements with at least two liquid crystal components, characterised in that at least one of these components is a cyclohexane derivative of the general formula (I)



in which the rings A and B are identical or different and are each a 1,4-disubstituted phenyl or cyclohexyl ring and X is —CO—O— or —O—CO—, R₁ is alkyl with 1—8 carbon atoms and R₂ is alkyl with 1—8 carbon atoms, and if the ring B is a phenyl ring R₂ is also alkoxy or alkanoyloxy with up to 8 carbon atoms or —CN.

7. Dielectric according to Claim 6, characterised in that it contains 1—40 per cent by weight of one or more cyclohexane derivatives of the general formula (I).
8. Use of a cyclohexane derivative of the general formula (I)



in which the rings A and B are identical or different and are each a 1,4-disubstituted phenyl or cyclohexyl ring and X is —CO—O— or —O—CO—, R₁ is alkyl with 1—8 carbon atoms and R₂ is alkyl with 1—8 carbon atoms, and if the ring B is a phenyl ring R₂ is also alkoxy or alkanoyloxy with up to 8 carbon atoms or —CN, as a component of a dielectric for liquid crystal display elements.

$$R_1 - \text{H} - \text{A} - \text{X} - \text{B} - R_2$$
$$R_1 - \text{H} - A - X - B - R_2$$
$$R_1 - \text{H} - \text{A} - \text{X} - \text{B} - R_2$$

R_2 un alcoyle ayant de 1 à 8 atomes de carbone ou encore, lorsque le noyau B est un noyau phényle, un alcoxy ou un alcanoyloxy ayant jusqu'à 8 atomes de carbone ou —CN, comme composants d'un diélectrique pour éléments d'affichage à cristaux liquides.

to the fact that the Commission has not yet
been able to find any evidence of a
direct relationship between the
Commission and the Commission.