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D E C I S I O N  
of 16 October 1995

Case Number: T 0858/92 - 3.3.3

Application Number: 87119309.0

Publication Number: 0274128

IPC: C08G 65/22

Language of the proceedings: EN

Title of invention:  
Liquid-crystalline polymer

Applicant:  
IDEMITSU KOSAN COMPANY LIMITED

Opponent:  
-

Headword:  
-

Relevant legal provisions:  
EPC Art. 56

Keyword:  
"Inventive step (yes)-after provision of further evidence"

Decisions cited:  
-

Catchword:  
-



Case Number: T 0852/92 - 3.3.3

**D E C I S I O N**  
of the Technical Board of Appeal 3.3.3  
of 16 October 1995

**Appellant:**

IDEMITSU KOSAN COMPANY LIMITED  
1-1, Marunouchi 3-chome  
Chiyoda-ku  
Tokyo 100 (JP)

**Representative:**

Strehl Schübel-Hopf Groening & Partner  
Maximilianstrasse 54  
D-80538 München (DE)

**Decision under appeal:**

Decision of the Examining Division of the European  
Patent Office dated 22 April 1992 refusing  
European patent application No. 87 119 309.0  
pursuant to Article 97(1) EPC.

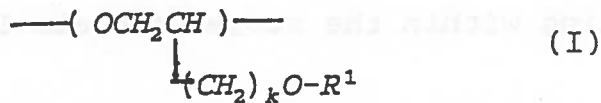
**Composition of the Board:**

**Chairman:** C. Gérardin  
**Members:** H. H. R. Fessel  
J. A. Stephens-Ofner

Summary of Facts and Submissions

I. The appeal lies against the decision of the Examining Division 2.1.02.012 dated 22 April 1992 to refuse European patent application 87 119 309.0 filed on 29 December 1987 in the name of Idemitsu Kosan Company Limited, Tokyo(JP) claiming JP-priorities of 29 December 1986 (JP 309466/86) and 17 November 1987 (JP 288475/87 and 288476/87). The decision was based on a set of 6 claims as originally filed of which the only independent Claim 1 reads as follows:

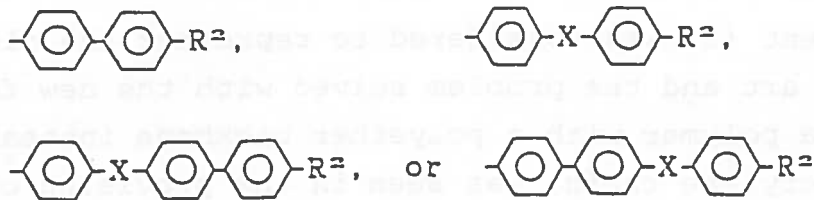
"A liquid-crystalline polymer comprising repeating units of the general formula (I)



in which:

k is an integer from 1 to 30; and

R' is



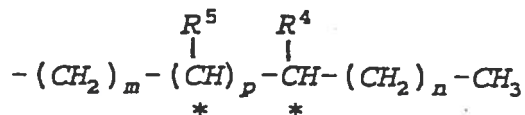
where:

X is -COO-cr -OCO-; and

R<sup>2</sup> is -COOR<sup>2</sup>, -OCOR<sup>2</sup>, or -OR<sup>2</sup>

where:

R<sup>3</sup> is



R<sup>4</sup> and R<sup>5</sup> being each independently -CH<sub>3</sub>, a halogen radical, or -CN, m and n being each independently an integer from 0 to 10 with the proviso than n is not 0 when R<sup>4</sup> is -CH<sub>3</sub>, p being 0 or 1, and C marked with \* being an asymmetric carbon atom."

The dependent claims concern preferred embodiments falling within the scope of Claim 1.

II. The reason for the decision was that the subject-matter as defined in claim 1 was deemed to be novel, but did not involve any inventive step vis-à-vis the teachings of documents

- (1) EP-A-0 184 482, and
- (2) EP-A-0 228 703.

Document (1) was considered to represent the closest prior art and the problem solved with the new feature, i.e. a polymer with a polyether backbone instead of a polyacrylate chain, was seen in the provision of further comb-like polymers. Owing to the limited number of feasible approaches an obvious solution was to provide the mesogenic monomers of document (1) with easily polymerizable terminal groups other than the acrylic

groups, which would not be expected to interfere with other parts of the monomer, such as an epoxy group known to readily form a polymeric backbone by polyaddition reaction.

The arguments based on a prejudice resulting from the structure of the polymer backbone and the property of "ferroelectricity" not mentioned in (1) were rejected. As to document (2), due to the claimed priorities, it was only relevant for the subject-matter of Claim 1 with p = 1.

- III. A Notice of Appeal was lodged on 30 June 1992 against that decision together with payment of the prescribed fee. A Statement of Grounds of Appeal was received on 2 September 1992 together with an amended Claim 1 as the basis of an auxiliary request. The Appellants disputed the arguments and findings contained in that decision, and contended that the problem to be solved was to provide ferroelectric liquid-crystalline polymers which could display motion pictures and might also be advantageously used as display elements for large displays or curved displays; in other words, the problem was to provide polymers exhibiting at the same time ferroelectricity at temperatures around room temperature, a relatively broad temperature range for the smectic C\* phase and fast response to external factors. A test report wherein these properties for prior art polymers and claimed polymers were compared was submitted together with that statement.

IV. The Appellants requested:

that the decision under appeal be set aside and a patent be granted on the basis of Claims 1 to 6 as originally filed as main request or, alternatively, on the basis of Claim 1 as filed on 7 August 1995 and Claims 2 to 6 as originally filed as auxiliary request.

#### Reasons for the Decision

1. The appeal is admissible.
2. The subject-matter claimed in the main request is new, since none of the cited documents discloses polymeric liquid crystals having the same backbone and the same lateral mesogenic groups as defined in the claims, which confirms the finding of the Examining Division.
3. The present patent application is directed to liquid crystalline polymers with mesogenic side chains, hereinafter called comb-like polymers, exhibiting fast response to external factors and applicable in displays.
  - 3.1 Such polymers are disclosed in document (1) which the Board, like the Examining Division, regards as the closest state of the art. These thermotropic polymers, which are obtained by polymerisation of at least one acrylic monomer - acrylate, methacrylate or chloroacrylate - having a specific ester structure, are characterized by an acrylic backbone and mesogenic groups with an optically active carbon atom which are linked to that backbone through a polymethylene chain or spacer (Claim 1). The definition of the (meth)acrylic monomer is such that the mesogenic groups and spacers satisfy the requirements of formula (I) in Claim 1 of

the application. These prior art liquid crystalline polymers are said to change their orientation in an electric field as quickly as liquid crystals of low molecular weight, which should make them suitable in displays and for the storage of information (page 2, lines 4 to 8). However, as specified in the introduction of this application, such low molecular weight liquid crystal compounds would not be suitable for large displays or curved displays, which require an accurate adjustment of the space between glass substrates. Moreover, such polymers generally exhibit slow response in the change of their transmission intensity to change of external factors, in particular electric field.

3.2 In the light of these shortcomings the technical problem underlying the application in suit may thus be seen in the provision of liquid crystalline polymers which have such a high speed of response to external factors that they can display motion pictures and may further be used as display elements for large displays or curved displays.

3.3 According to the application in suit this problem is to be solved by a liquid crystalline polymer as specified in Claim 1, e.g. based on a polyethylene oxide backbone and containing very similar or even identical mesogenic groups.

3.4 The comparative test report submitted together with the Statement of Grounds of Appeal (pages 8 to 11) provides evidence that the various aspects of the above-defined technical problem are effectively solved.

3.4.1 In test (1), which was carried out with an acrylic polymer having a number of average molecular weight of 4500 within the terms of document (1), a response time to electric field of 0.26 s at 45°C has been measured.

By contrast, in the case of the polymers according to the application in suit used in tests (2), (4) and (6), response times of 0.003 s, 0.005 s and 0.003 s respectively have been obtained. As explained by the Appellant, the response times have not been measured in test (1) at the same temperature as in the other tests because of the difference of the temperature ranges in which the various polymers exhibit the smectic C\* phase. Although the response time of the claimed polymers was measured at a lower temperature, it is by two orders of magnitude shorter than that of the polymer described in document (1).

3.4.2 Marked differences in the phase behaviour have also been observed with the same polymers. Whilst the prior art liquid crystalline polymer exhibits the smectic C\* phase between 41 and 52°C (test (1)), the claimed polymers exhibit the smectic C\* phase at temperatures including room temperature in a wider temperature range: between 1 and 33°C in tests (2) and (6), and between -9 and 30°C in test (4).

3.4.3 This comparative test report clearly shows that the polymers as claimed respond to electric fields considerably faster and exhibit a smectic C\* phase at temperatures around room temperature in a broader temperature range than prior art polymers, which ensures that they maintain ferroelectric properties even at slightly varying temperatures and makes them suitable for the above mentioned applications. By the same token, these results demonstrate that the liquid crystalline polymers described in document (1) do not possess such ferroelectric properties and that, consequently, it was justified to define the technical problem not in alternative terms as in the appealed decision, but in positive terms.

4. It remains to be decided whether this modification of the polymer backbone is obvious having regard to the teaching of documents (1) and (2).
- 4.1 As mentioned above, the backbone of the polymers described in document (1) derives from specific acrylic monomers, e.g. an acrylate ester of a given formula or the corresponding methacrylate or the corresponding chloroacrylate, and no other possibilities are envisaged in that citation. This means that the skilled person faced with the above defined problem would get no information whatsoever for that purpose and could at most carry out optimization tests within the teaching of document (1), e.g. change the acrylic monomer and/or modify the length of the spacer, which would not lead to an entirely different backbone. In fact, this document would not even be considered by a skilled person, since there is no mention of ferroelectric properties.
- 4.2 Document (2), which is published on 15 July 1987 and is thus prior art for the issue of inventive step only to the extent the two priorities of 17 November 1987 are concerned, e.g. only for the embodiments of Claim 1 of the application corresponding to p being 1, describes ferroelectric liquid crystal polymers. These polymers not only exhibit a ferroelectricity even at temperatures in the vicinity of a room temperature, but also have so fast response speed to the external factors as to be able to display motion pictures, and further may be advantageously used as display elements for large size screens and curved screens (page 1, lines 6 to 20). These polymers are obtained by polymerising an acrylate monomer of specific formula (page 4, lines 16 to 22).

Although these general properties may seem at first sight to correspond to the combination of properties aimed at in the application, this teaching is in fact

irrelevant for the solution of the technical problem. First, like in the case of document (1), there is no suggestion of an alternative backbone, let alone of a polyether backbone, which means that there is no incentive for a skilled person to deviate from that basic teaching. Secondly, the comparative test report submitted by the Appellant shows that the response times to electric field measured in tests (3) and (5), which have been carried out with polymers within the terms of document (2), are 0.012 s and 0.025 s respectively, whilst in the experiments carried out in tests (2), (4) and (6) with polymers according to the application values as low as 0.005 s and 0.003 s are obtained. This clearly shows that, even if document (2) were to be considered, the level of properties a skilled person could expect by operating according to that teaching would still be unsatisfactory.

- 4.3 Thus, neither document (1) in the general case, nor document (2) in the particular case when  $p$  is 1, nor even a combination thereof render obvious the structural modifications of the liquid crystalline polymers, so that the claimed subject-matter involves an inventive step.
- 4.4 Claim 1 being allowable, the same applies to dependent Claims 2 to 6 which are directed to preferred liquid crystalline polymers according to Claim 1 and the patentability of which is supported by that of the main claim.
5. These considerations show that the line of argumentation adopted by the Examining Division relied on two assumptions which were not justified.

The first assumption that, because document (1) mentions both the orientation of the polymers in an electric field and their possible suitability for displays, these polymers should exhibit the same ferroelectric properties as the claimed polymers, has no support. The Board is not aware that liquid crystallinity implies ferroelectricity and has not found any evidence in its investigation for such a general statement. Moreover, as pointed out by the Appellant in the Statement of Grounds of Appeal (page 4, point II.3), document (1) does not provide any data for the transition temperatures from the crystalline or glassy state of the polymer to the low-temperature mesophase, which is an essential parameter concerning the possible uses of a liquid crystalline polymer. It was not proper in the absence of evidence to rely on allegedly implicit disclosures.

The second assumption that the polyether backbone was an obvious solution is not supported by any evidence, since neither document (1), nor document (2) mention or even suggest such a structure, let alone in connection with ferroelectricity properties. It may be that a skilled person could have considered such a structure in the framework of routine investigation, but he would not have done so in the expectation of improved ferroelectric properties. Thus, in the absence of any evidence pointing at polyether backbone, the alleged obviousness amounts to hindsight.

6. Since the main request can be granted, there is no need to consider the auxiliary request.

Order

For these reasons it is decided that:

1. The decision under appeal is set aside.
2. The case is remitted to the Examining Division with the order to grant a patent on the basis of Claims 1 to 6 and the description, both as originally filed.

The Registrar:

  
E. Görgmaier

The Chairman:

  
C. Gérardin