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Aktenzeichen / Case Number / N<sup>o</sup> du recours : T 295/87 - 3.3.1

Anmeldenummer / Filing No / N<sup>o</sup> de la demande : 78 300 314.8

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Bezeichnung der Erfindung: Thermoplastic aromatic polyetherketones, a method  
Title of invention: for their preparation and their application as  
Titre de l'invention : electrical insulants

Klassifikation / Classification / Classement : C08G 65/40

## ENTSCHEIDUNG / DECISION

vom / of / du 06 December 1988

Anmelder / Applicant / Demandeur :

Patentinhaber / Proprietor of the patent /  
Titulaire du brevet :

ICI PLC

Einsprechender / Opponent / Opposant :

01 BASF AG  
02 BASF Lacke + Farben AG  
03 Union Carbide Corporation

Stichwort / Headword / Référence : Polyetherketones/ICI

EPÜ/EPC/CBE Art. 54, 56, 87, 100, 123, Rules 57, 58

Schlagwort / Keyword / Mot clé :

"Priority right (yes) - generic disclosure"  
"Novelty (yes) - explicit exclusion"  
"Inventive step (yes) - selection - non  
obvious modification of a process considered  
superseded"  
"Objection to the filing of additional claims  
in opposition."

Leitsatz / Headnote / Sommaire

I. In Opposition proceedings, under Article 101(2) and Rule 57(1) EPC the proprietor has a right to file observations upon a notice of opposition. Thereafter, observations from the parties are only admissible in the exercise of the discretion of the Opposition Division or a Board of Appeal, if such observations are necessary and expedient in the sense of Article 101(2) and Rule 57(3) EPC. It is in the interest of the efficient conduct of opposition proceedings that observations by parties should be properly limited to what is necessary and expedient. (see Reasons, paragraph 2).

II. Amendments to the text of a granted patent during opposition proceedings should only be considered as appropriate and necessary in the sense of Rule 57(1) and 58(2) EPC and therefore admissible if they can fairly be said to arise out of the grounds of opposition. An amendment proposing new claims having no counterpart in the granted patent, which is not in response to a ground of opposition, is not admissible (following Decision T 127/85 dated 1 February 1988) (see Reasons, paragraph 3).

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Boards of Appeal

Chambres de recours

Case Number : T 295 /87 - 3.3.1

D E C I S I O N  
of the Technical Board of Appeal 3.3.1  
of 06 December 1988



Appellant :  
(Opponent 03)

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Decision under appeal :

Interlocutory decision of the Opposition Division of  
the European Patent Office dated 26 May 1987  
concerning maintenance of European patent  
No. 0 001 879 in amended form.

Composition of the Board :

Chairman : K. Jahn

Members : C. Gérardin

G.D. Paterson

### Summary of Facts and Submissions

I. The mention of the grant of the patent No. 1879 in respect of European patent application No. 78 300 314.8 filed on 22 August 1978 and claiming priorities of 7 September 1977 and 13 January 1978 from two earlier applications GB 37345/77 and GB 1412/78 was published on 24 March 1982 on the basis of 14 claims.

Claim 1 reads as follows:

"A crystalline thermoplastic aromatic polyetherketone containing the repeating unit



alone or in conjunction with other repeating units characterised in that said polymer is tough, having an inherent viscosity IV of at least 0.7 (which corresponds to a reduced viscosity RV of at least 0.8)".

The further independent claims concern the production of a polymer containing the repeat unit I (Claim 7) and an electrical insulation comprising a polymer containing the repeat unit I (Claim 14).

II. Opponent I filed an opposition against the grant of the patent on 9 December 1982 on the grounds of lack of novelty of the product claims and lack of inventive step of the process claims. It was also objected that the two earlier applications used for claiming of priority were not the first applications disclosing the alleged invention.

On 16 December 1982 Opponent 2 gave notice of opposition to the granted patent and requested revocation thereof for non-compliance with the requirements of Articles 54 and 56 EPC.

On 24 December 1982 Opponent 3 (the Appellant) also filed an opposition against the grant of the patent and requested revocation thereof on the grounds of lack of novelty and inventive step as well as insufficient disclosure of the invention to enable a skilled man to carry it out.

A further point which came up fairly late in the procedure concerns the exact structure of the polyetherketones. Experimental work showed that some specific recurrent units in copolymers were liable to chain scission and rearrangement; this structural phenomenon known as transesterification caused the actual copolymer to have an ultimate structure slightly different from the theoretical one.

These various objections which were emphasized in numerous later submissions as well as during oral proceedings were based essentially on the following documents:

- (7) Journal of Polymer Science, Part A-1, Volume 5 (1967), pages 2375 to 2398;
- (9) US-A-3 953 400;
- (10) Sales leaflets and papers published prior to 1977 by Raychem Corporation describing their polyarylene polyether called "STILAN";
- (12) CA-A-847 963;

(22) DE-A-2 803 873;

(25) GB Application 4009/77 filed 01.02.1977 (priority document of (22));

(26) Priority-founding Application GB 37345/77 filed 07.09.1977;

(27) Priority-founding Application GB 1412/78 filed 13.01.1978;

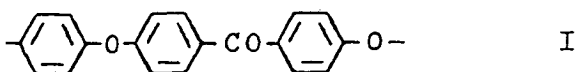
(28) US-A-3 956 240;

(29) US-A-4 268 635 = (31) DE-A-2 733 905;

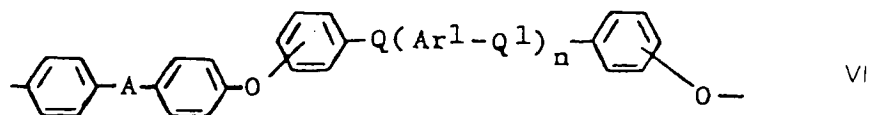
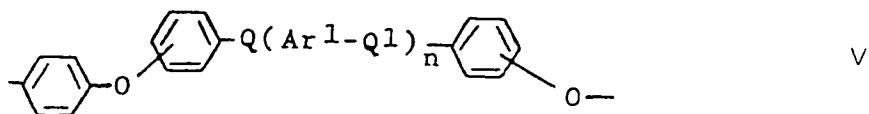
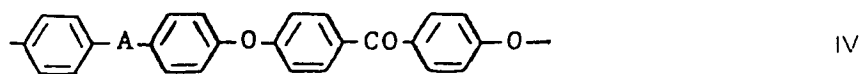
(30) US-A-4 105 636.

III. By a decision dated 26 May 1987, the Opposition Division maintained the patent in amended form on the basis of a new set of 14 claims, of which Claim 1 reads as follows:

"A tough crystalline thermoplastic aromatic polyetherketone consisting essentially of the repeating units I

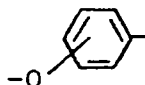


alone or the repeating unit I in conjunction with up to 50 mole % of at least one other repeating unit selected from the following repeating units IV, V and VI



or obtainable by the process of Claim 9,  
where

A is a direct link, oxygen, sulphur,  $-SO_2-$ ,  $-CO-$ , or a divalent hydrocarbon radical;  
the oxygen atoms in sub-units



are ortho or para to the groups Q and Q<sup>1</sup>;  
Q and Q<sup>1</sup>, which may be the same or different, are  $-CO-$  or  $-SO_2-$ ; Ar<sup>1</sup> is a divalent aromatic radical; and  
n is 0, 1, 2 or 3;  
said polymer having an inherent viscosity (IV) of at least 0.7 (which corresponds to a reduced viscosity (RV) of at least 0.8)".

Whereas Claim 9 was drafted as a process claim including the process features of Claim 7 as granted, but directed to the preparation of the above products, there were additional product claims which had no counterpart in the set of claims as granted, especially Claims 3 and 4.

Claim 3: A polyetherketone according to either Claim 1 or Claim 2 which contains up to 30 mole % of the repeating units IV, V and/or VI.

Claim 4: A polyetherketone according to Claim 1 which is the product obtainable by polycondensing hydroquinone, 4,4'-dihydroxybenzophenone and 4,4'-difluorobenzophenone.

The reasons in this decision can be summarized as follows:

The formulation of the claims on file meets the requirements of Article 123 EPC. Especially the product-by-process element of Claims 4 and 7 is necessary in view of the NMR spectra submitted by the patentee which show that the polymers do not have the theoretically predictable units originally claimed.

Concerning priority, polymers containing recurring units specifically derived from hydroquinone and 4,4'-difluorobenzophenone are not suggested in any of the documents (25), (30) and (31), so that the priority derived from documents (26) and (27) is correctly claimed. The polyetherketones disclosed in document (7) do not have the required inherent/reduced viscosity, so that novelty can be acknowledged.

Both the process and the products are inventive since neither documents (9) and (28) which teach the electrophilic method, nor documents (7) and (12) which do not mention the problems associated with the use of sodium carbonate alone nor suggest to carry out the polycondensation in presence of aromatic sulphones, can lead to the operative and structural features claimed in the disputed patent.

IV. The Appellant (Opponent 3) thereafter filed a notice of appeal on 11 July 1987 and paid the prescribed fee at the same time. The arguments presented in the Statement of Grounds filed on 24 September 1987, in the later submissions and during oral proceedings held on 6 December 1988 were based on several additional documents, especially US-A-4 105 635 (document (39)); these arguments can be summarized as follows:

The introduction of the wording "obtainable" serves to extend the scope of several product claims to include polymers of unspecified structure as well as polymers prepared by any process, which offends Article 123 EPC. This applies especially to the product according to Example 14 which is claimed in Claim 4 together with its transesterified products.

Documents (22), (30) and (39) which were all filed before the filing date of the disputed patent disclose polymers falling within the scope of the original invention. This means that the priority is falsely claimed and that document (22) becomes relevant as novelty destroying.

Should the priority be acknowledged, novelty of the polymer claims could not be established unambiguously because of transesterification which affects the structure of the polymer. However, even if novelty were to be demonstrated, the subject-matter would not involve an inventive step, since all the information necessary for the alleged invention was available: useful properties of aromatic polyetherketones in document (7), crystalline properties thereof from documents (9) and (28), differences in terms of reactivity between chlorine and fluorine as well as choice of appropriate solvents from document (12).



Finally, objections to the scope of the claims directed especially to the absence of an upper limit for the inherent viscosity and to the large number of copolymers encompassed in Claim 1, are raised.

- V. The arguments presented by the Respondent (Patentee) in writing and during the oral proceedings held on 6 December 1988 can be summarized as follows:

Claims directed to products obtainable by processes are allowable if the products cannot be defined structurally. Inclusion of the product obtainable by the process of Claim 9 in the version accepted by the Opposition Division is justified on technical grounds, and meets the need to grant a claim covering a reasonable range of copolymers where a homopolymer has been shown to be inventive. If it is reasonable to predict that the variants covered by the claims have the claimed properties or uses, the Respondent should be allowed to draw his claims accordingly. A claim covering transesterified polymers is justified in view of the decisions T 150/82 and T 219/83; it does not extend to newly discovered matter, but merely includes the possibility of ether interchange.

As far as priority is concerned, document (22) can be disregarded and documents (30) and (31) are only general disclosures; by contrast, the products presently claimed require the presence of specific recurring units to which the selection principles defined in the decision T 12/81 apply.

As to the question of inventive step, it is enough to state that by contrast to documents (9) and (28) which teach the electrophilic route, the Respondent has chosen the nucleophilic route known from document (7) to be impracticable; moreover, there was no incentive from the

prior art to prepare polyetherketones based on p-dioxyphenylene and 4,4'-benzophenone sub-units since they have an unfavourable ether:ketone ratio.

VI. During oral proceedings the following set of claims was filed as the main request:

Claim 1 as allowed by the first instance with the restriction that only the alternative "product-by-process" is retained (deletion of "or")

Claims 2 to 4 correspond as dependent product claims to the granted version of Claims 2, 4 and 6

In Claim 5 which corresponds to the granted version of Claim 7, it is specified that up to 50 mole% of other repeating units may be present in the polyetherketone

Claims 6 to 11 correspond as dependent process claims to the granted version of Claims 8 to 13

In Claim 12 it is specified that the polymer for electrical insulation is selected among the polyetherketone according to any one of Claims 1 to 4.

VII. Although as parties to the appeal under Article 107 EPC Opponents 1 and 2 were duly summoned, they did not appear in the oral proceedings.

VIII. The Appellant requested that the decision under appeal be set aside and that the patent be revoked.

The Respondent requested that the appeal be dismissed and that the patent be maintained on the basis of Claims 1 to 12 submitted during oral proceedings.

At the end of the oral proceedings the decision was announced that the patent was maintained in accordance with the Respondent's request.

#### Reasons for the Decision

1. The appeal complies with Articles 106 to 108 and Rule 64 EPC and is, therefore, admissible.

#### Procedural matters

2. The proceedings before the Opposition Division were characterized by many lengthy submissions in writing from all the parties over a period of nearly four years between the filing of the notices of opposition in December 1982 and the oral hearing in September 1986, and provide an illustration of how an opposition proceedings should preferably not be conducted under the provisions of Article 101 and Rules 57 and 58 EPC.

It is to be noted that Article 101(2) EPC provides that "the Opposition Division shall invite the parties, as often as necessary, to file observations ... on communications from another party or issued by itself". Furthermore, Rule 57(1) and (2) EPC is concerned with the initial stage of an opposition proceedings, immediately following the filing of the notice(s) of opposition, and clearly provides the patentee with an opportunity as of right to file observations in reply to such notice(s) of opposition. Thereafter, however, by way of contrast, Rule 57(3) EPC emphasizes that following communication of the patentee's observations (and any amendments) to the other parties, such other parties shall only be invited by the Opposition Division to reply to such observations "if it considers it expedient".

Although Article 101(2) and Rule 57 EPC only specifically refer to the criteria which the Opposition Division should use when considering whether to invite the filing of observations, in the Board's view it is clearly and necessarily implicit in these provisions that, in the absence of an express invitation from the Opposition Division, the parties may only file observations as a matter of discretion, when the Opposition Division considers them to be "necessary" or "expedient", in the sense discussed above. It would make a nonsense of these provisions to interpret them as providing that the Opposition Division should only invite observations from parties when it is considered "necessary" or "expedient", but that the parties can file observations as a matter of right even when they are unnecessary or inexpedient. (In this connection reference is made to Decision T 406/86 dated 2 March 1988, to be published).

It is clearly most desirable in the interest of the smooth and efficient conduct of opposition proceedings, and accordingly in the public interest, that observations by parties should be properly limited to what is necessary and expedient. This in turn requires the exercise of a proper control by the Opposition Division (and, mutatis mutandis, by a Board of Appeal) over the admissibility of observations by parties as well as of documents filed in support of such observations. Of course, the extent to which further observations from parties are necessary or expedient depends upon various factors, including the complexity of the issues raised, and can only be decided in the context of each individual case. Nevertheless, it should be recognized that, in appropriate cases, both the Opposition Division and the Boards of Appeal have the power, and indeed the duty, to refuse to admit observations and/or supporting documents for consideration

in the opposition and, respectively, the appeal, in the exercise of discretion under Articles 101(2) and 114(2) and Rule 57(3) EPC.

Attention is hereby drawn to the statement of "General Principles" applying to Opposition procedure which is contained in the Information from the European Patent Office published in OJ EPO 1985, 272, which the Board endorses: "The EPO's aim is to establish as rapidly as possible, in the interests of both the public and the parties to the opposition proceedings, whether or not the patent may be maintained given the opponent's submissions. It seeks to achieve this by means of a speedy and streamlined procedure, which implies firm control by the Opposition Division at all stages. This requirement must however be balanced against the need to allow the parties to present their cases adequately so that the correct decision can be made."

In the present case, at an early stage of the oral proceedings the Board made it clear that supporting documents which had not been filed in due time would only be considered as admissible provided the Board was satisfied that they were sufficiently relevant. However, in the Board's view, a stonger control could have been exercised by the Opposition Division in relation to the admissibility of the parties' extensive observations which were filed, by applying the principles of Article 101 and Rule 57 EPC as discussed above during the examination stage of the opposition.

3. Also at an early stage of the oral hearing the Board raised the question of the admissibility of Claims 3 and 4 as accepted by the Opposition Division and set out in paragraph III above, since their subject-matter was new in comparison with the claims as granted. The Board decided

that such claims were not admissible for the reasons which follow, and accordingly the Respondent filed a set of claims as his main request during the oral hearing, which did not include the subject-matter of said Claims 3 and 4.

Decision T 406/86, already mentioned above, contains a discussion concerning the admissibility of amendments to the text of a patent during opposition proceedings, and in particular makes clear that the filing of amendments during opposition proceedings is a matter of discretion under Rules 57(1) and 58(2) EPC. As is stated in that decision, such amendments are only admissible if they are "appropriate" and "necessary", having regard to the nature of the grounds of opposition and the issues raised thereby. In the Board's view, amendments to the text of a granted patent during opposition proceedings should only be considered as "appropriate" and "necessary" in the sense of Rules 57(1) and 58(2) EPC and therefore admissible, if they can fairly be said to arise out of the grounds of opposition laid down in Article 100 EPC. In the Board's judgement, the opposition procedure provided under Articles 100 to 102 EPC and the relevant Implementing Regulations in particular Rules 57 and 58 EPC, is designed to provide an examination of the validity of a patent on the basis of the objections to validity raised under Article 100 EPC. Opposition proceedings are not an opportunity for the patentee to propose amendments to the text of a patent for purposes which are not clearly related to meeting a ground of opposition raised under Article 100 EPC. In particular, they do not provide an opportunity to include new subject-matter in the claims which may have adequate support in the original description, but has not previously been claimed as such.

In the present case, Claim 4 was directed to the resulting polymer according to Example 14 and Claim 3 concerned a preferred embodiment, namely a specific molar ratio of units IV, V and/or VI in the copolymer. In the Board's judgement, the addition of such claims, which had no counterpart in the granted version of the claims of the patent-in-suit, cannot be regarded as an attempt to respond to an objection under Article 100 EPC. They represent, in effect, amendments which go beyond the objections to validity actually raised and are not, therefore, either necessary or appropriate within Rules 57 and 58 EPC.

**Article 123 EPC.**

4. The Appellant regards the product-by-process claims, i.e. the introduction of the wording "polymers obtainable by a process" in product claims, as objectionable since this would serve only to extend protection to products of unspecified structure which were not encompassed within Claim 1 of the patent as granted.

4.1 The granted version of the claims included both product claims (Claims 1 to 6) and process claims (Claims 7 to 13) for the preparation of a crystalline thermoplastic polyetherketone containing the repeat unit I alone or in conjunction with other repeating units. The only structural requirement was thus the presence of the repeat unit I, whereas the other repeat units were not specified in Claims 1 and 7, neither quantitatively nor qualitatively. Claim 1 on file is nothing else than a combination of Claims 1 and 7 as granted wherein the other recurrent units, which were originally unspecified, have been incorporated as disclosed on page 5, lines 10 to 38. This formulation cannot result into a broader scope of the product claim, but into a narrower definition of the

polymers since unidentified repeat units are no longer left open; moreover, because of the reference to the process, it implicitly encompasses the transesterified products.

In fact, the product-by-process formulation is fully in line with the decision T 150/82 dated 7 February 1984 published in OJ EPO, 1984, 309, wherein the Board regarded as allowable the drafting of such claims in order to define certain natural products or macromolecular products, of unidentified or complex composition which have not yet been defined structurally, in as much as they meet the basic criteria of patentability. The decision states that such form of claims should be reserved for cases where the product cannot be satisfactorily defined by reference to its composition, structure or some testable parameters (points 8 and 10).

This is the situation in the present case, since the claimed polymers cannot be defined accurately by means of their structure because of the phenomenon of transesterification which occurs to a certain extent, but only by process parameters.

- 4.2 During oral proceedings the Appellant further objected to the presence of the wording "obtainable" in Claim 1 which had not been introduced in order to overcome a possible objection of lack of novelty and/or inventive step based on prior art teachings, but merely in order to take into account the possible presence of transesterified products of unspecified structure. This phenomenon of transesterification which was not mentioned at all in the original application came up for discussion fairly late in opposition procedure, and eventually became at the appeal stage the major argument supporting the objection under Article 123 EPC. The Appellant submitted that trans-



etherification was already mentioned in document (29) which was filed on 13 August 1976 by the Respondent in the name of the same inventor as the patent-in-suit, but two years before the latter was filed, and that consequently the Respondent must have been aware of this phenomenon for the claimed polymers at the priority date of the patent-in-suit; the Respondent's proposed amendments should therefore be refused also in the exercise of discretion.

Document (29) describes the preparation of aromatic polyethers containing ketone and sulphone groups which, unlike prior art copolymers with the same recurrent units which were random copolymers (column 1, line 35 to column 2, line 23), are believed to contain block structures as evidenced by their higher glass transition temperature and melting point (column 2, lines 37 to 41 and Example 1). Although the chain growing mechanism is basically a grafting reaction which involves the phenate end-groups of the polyethersulphone block and the halogen end-groups of the polyetherketone block, the liability of polyetherketones to attack by nucleophiles makes it also possible to graft onto the polyetherketone block via attack at its ether linkages; this ether cleavage which results in the formation of a random copolymer can be controlled by keeping the concentration of phenate end groups as low as possible, in practice by suspending the polyetherketone in a finely divided form in a solution of the polyethersulphone in a dipolar aprotic solvent (column 3, lines 39 to 55; column 7, lines 13 to 23).

In fact, as convincingly demonstrated by the Respondent, the awareness of the possibility of transesterification in the preparation of the block copolymers according to document (29) did not provide any information about the extent of this phenomenon for polymers specifically derived from hydroquinone and benzophenone, nor about

possible methods to prevent it, all the more, as will be demonstrated hereinafter, as the latter polymers could not be prepared by the nucleophilic route at that date. The first quantitative study of transesterification based on  $^{13}\text{C}$  NMR analysis concerning aromatic polyetherketones was available only shortly before the oral proceedings in the opposition procedure (Appendix 1 of the statement filed by the Respondent on 4 August 1986 in response to the Appellant's submissions concerning transesterification). It shows that the percentage of transesterification varies from polymer to polymer and that for a given polymer it depends on the polycondensation conditions; as far as the copolymer according to Example 14 of the patent-in-suit is concerned, the presence of repeat units different from the structure of the starting compounds is evidence that transesterification does occur to a certain extent (page 3, last paragraph to page 5, paragraph 3). Later investigations, to which the Respondent referred in oral proceedings at the appeal stage, have brought to light that, whereas the extent of transesterification may be unpredictable, the structural rearrangement of the main polymer chain does not occur at random; in practice, in nucleophilic process scission can only occur between an oxygen atom and a carbonyl group, not between two oxygen atoms.

The Board considers that the possible presence of such units of unspecified structure is taken care of in the formulation of Claim 1 not by the word "obtainable" which is regarded as equivalent to "capable of being obtained", but by the word "essentially". It follows that the actual scope of Claim 1 does not extend beyond that of the granted version wherein only the repeat unit I was specified as contained within the polyetherketone.

In the Board's judgement the amended version of Claim 1 requested by the Respondent is admissible having regard to Article 123 EPC and in the exercise of its discretion.

- 4.3 More formally, the wording of the claims does not extend beyond the scope of the original disclosure. With regard to the granted version of the claims, Claim 1 represents a combination of Claims 1, 3 and 5 including as well the polymers of repeat unit VI disclosed on page 5, lines 29 to 38, all of these units being possibly present up to 50 mole% according to page 5, lines 8 and 38, which combination has been drafted as a product-by-process claim, i.e. a product obtainable by the process according to the independent process Claim 5.

As to the other claims, they only differ by their number and the number of the claims they are related to, so that the claims are acceptable under Article 123 EPC.

Since the present set of claims is based on the same category of claims as the granted version, all the requirements of Article 123 EPC are thus met.

#### Article 83 EPC

5. The two objections raised by the Appellant concerning the scope of the claims cannot be accepted.

The first objection concerns the broad range of polymers, especially copolymers, which are embraced within the scope of Claim 1. First of all, as conceded by the Appellant in the statement filed on 1 November 1988 (point 8(1)) and as apparent from the numerous documents on file, it is usual in the field of polymers to extend the scope of a claim to a reasonable range of copolymers where a homopolymer has been shown to be inventive. In the present case, the

claimed polymers encompass copolymers defined not only by their structure, i.e. a majority of recurrent units derived from hydroquinone and 4,4'-difluorobenzophenone, but by their properties as well, i.e. crystallinity and toughness. At first sight, there does not seem to be any incompatibility between these two properties. That this dual condition cannot be met by some polymers within the scope of Claim 1 has never been demonstrated by the Appellant, who has the onus of proof; nor is the Board able to establish the facts of its own motion. In such a situation, it is the party whose arguments rests on the alleged facts who loses thereby, as already specified in the decision T 219/83 dated 26 November 1985 published in OJ EPO, 1986, 211, for it is not sufficient in opposition proceedings for the opponent to impugn a granted patent with an assertion which cannot be substantiated (point 12, paragraphs 4 and 5). It was thus up to the Appellant to demonstrate that the combination of recurrent units and properties as claimed could not be achieved and show thereby that the protection sought was in no relation to the actual invention.

As to the absence of upper limit for the range of reduced viscosity, in the Board's judgement there is not any undue protection sought, since there is a value of reduced viscosity beyond which the polymer could not be processed any more; it must be presumed that the skilled man has such basic knowledge.

#### Priority date

6. The Appellant contends that the disputed patent is not entitled to the claimed priority since the same invention was already disclosed in documents (25) (the priority document for document (22)), (30) and (39) which were filed by the Respondent more than 12 months before the

European patent application.

This contention is based upon and derived from the provisions of Articles 87 to 89 EPC which are the provisions of the EPC concerned with priority rights and which reflect the international priority system originally set up by the Paris Convention for the Protection of Industrial Property. In particular, Article 87(1) EPC provides that "A person who has duly filed ... an application for a patent ... shall enjoy, for the purpose of filing a European patent application in respect of the same invention, a right of priority during a period of twelve months from the date of filing of the first application."

It is clearly inherent in the priority system provided by Articles 87 to 89 EPC that when a person files a first application in respect of a particular invention in a Union country, he only enjoys a right of priority for a period of twelve months from the filing date of that first application. In this connection Article 87(2) and (3) EPC refers to "Every filing ... shall be recognized as giving rise to a right of priority ... whatever may be the outcome of the application."

In the present case the question arises whether earlier patent applications, i.e. documents (25), (30) and (39), filed by the Respondent more than twelve months before the European patent application on which the patent-in-suit was granted, are applications "in respect of the same invention" as the subject of the patent-in-suit.

- 6.1 Document (22) which was filed on 30 January 1978 relates to the production of aromatic polyethers containing sulphone and ketone linkages comprising the polycondensation of at least one bisphenol and at least one dihalobenzenoid

compound with a mixture of two alkali metal carbonates or bicarbonates of different alkali metals and in presence of an aromatic sulphone as solvent (Claims 1 and 6). The last two examples describe explicitly the preparation of polyetherketones derived from hydroquinone and 4,4'-difluorobenzophenone in presence of diphenylsulphone and with potassium carbonate (Example 18) or a mixture of sodium carbonate and potassium carbonate (Example 19). However, this specific teaching is not to be found in document (25) filed on 1 February 1977, which is the priority document for document (22). Whereas the possibility of using hydroquinone is mentioned in the description of document (22) (page 8, line 1), this compound is excluded from the teaching of document (25) which is directed to the use of bisphenols with two aromatic nuclei (page 3, lines 1 to 10 and Examples). Thus in the Board's judgement document (25) does not constitute an application in respect of the same invention as the patent-in-suit.

- 6.2 Document (30) was filed on 11 July 1977 and concerns the preparation of aromatic polyether comprising boiling an inert organic sulphoxide or sulphone solvent containing (i) a substantially equimolar mixture of (a) at least one bisphenol and (b) at least one dihalobenzenoid compound or (ii) at least one halophenol, in which dihalobenzenoid compound or halophenol the halogen atoms are activated by -SO<sub>2</sub>- or -CO- groups ortho or para thereto, and an alkali metal carbonate, the amount of said carbonate being such that there is at least one alkali metal atom for each phenol group present, and removing water by distillation in the absence of an azeotrope forming solvent (Claim 1). Although the specific compounds required in the process claimed by the Respondent are all mentioned in this document, they appear in lists of compounds of some length; in this regard, no difference is made between

dichloro- and difluorobenzophenone (column 2, lines 37/38), hydroquinone wrongly classified as bisphenol is not quoted among the particularly preferred "bisphenols" (column 1, lines 65 to 68), the solvent may be an aliphatic or aromatic sulphoxide or sulphone (column 3, lines 29 to 52) and the alkali metal carbonate is to be preferably selected between sodium and potassium carbonate (column 3, line 53 to column 4, line 15). In fact, document (30) is a generic teaching which is directed to the preparation of high molecular weight aromatic polyetherketones as well as polyethersulphones without using an azeotrope former as in prior processes, but by merely removing water by distillation during polycondensation (column 1, lines 33 to 38). This broad teaching may thus encompass the subject-matter of the patent-in-suit as the Appellant put forward, but it does not disclose it.

This conclusion is in line with the criteria of novelty specified in the decision T 12/81 dated 9 February 1982 published in OJ EPO 1982, 296. According to this decision, if two classes of starting substances are required to prepare the end products and examples of individual entities in each class are given in two lists of some length, then a substance resulting from the reaction of a specific pair from two lists can nevertheless be regarded for patent purposes as a selection and hence as novel (point 13). This principle applies all the more in the present case as the process involves, not only the selection of two starting compounds, but the combination thereof with specific operative features which are themselves chosen among several possibilities.

- 6.3 Document (39) was filed on 28 June 1977 and concerns the preparation of a similar broad class of aromatic polyethers with ketone and sulphone groups in the main

polymer chain (Claim 1). Like document (30), this document does not suggest the specific combination of features as claimed in the patent-in-suit, even if hydroquinone and 4,4'-difluorobenzophenone are both cited among the preferred starting compounds (column 1, line 64 to column 2, line 1 and column 2, lines 32 to 45). Again therefore document (39) is not in respect of the same invention as is the subject of the patent-in-suit.

Even Example 1, to which the Appellant referred more particularly during oral proceedings, does not disclose a polymer falling within the scope of Claim 1. If one represents an ether linkage by E, a ketone group by K and a sulphone group by SO<sub>2</sub>, this polymer obtained from 0.0805 mole of the hydrate dipotassium salt of 4,4'-hydroxybenzophenone, 0.0651 moles of 4,4'-dichlorobenzophenone and 0.0163 moles of 4,4'-dichlorodiphenylsulphone can be represented by



Although this recurrent unit may be decomposed in a majority of EKE sub-units which would correspond to the basic EEK unit of the polymer according to the disputed patent, it cannot include an EE sequence and therefore cannot be regarded as describing the polymers presently claimed which derive from hydroquinone.

- 6.4 In conclusion, although aromatic polyetherketones were generally known at the priority date of the disputed patent and although it may be that specific polymers within the subject-matter of the patent-in-suit were disclosed within documents (25), (30) and (39), none of these documents can be regarded as disclosing the specific subject-matter of the patent-in-suit and therefore cannot be regarded as applications "in respect of the same



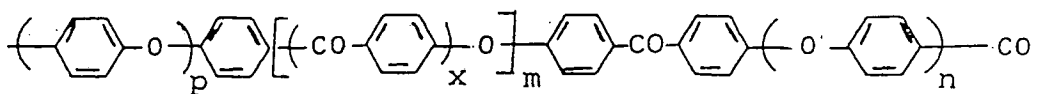
invention" as the patent-in-suit (Article 87(1) EPC). This means that the priority of the patent-in-suit is properly claimed from documents (26) and (27).

Novelty

7. Although in the Statement of Grounds (page 17, point 18) the Appellant conceded, on the assumption that the priority stood, that the subject-matter of the patent-in-suit would be novel, the issue of novelty was raised again during oral proceedings on the basis of the disclosure of documents (9) and (28).

7.1 Document (9) describes a melt processable polymer with repeating units of formula EK having a mean inherent viscosity within the range of 0.8 to 1.65 (column 2, lines 54 to 61). Although these polymers may incorporate comonomers in order to enhance or modify specific properties such as strength, crystallinity and melting point, the compounds actually exemplified (column 12, lines 11 to 31) cannot lead to polymers of repeat unit I or any combination thereof with units IV to VI as required in Claim 1 of the patent-in-suit. This applies particularly to the polymer shown at columns 5/6, line 30 which can be represented by EKEK or simply EK; even when this polymer is capped with diphenyl ether (column 4, Table 1, and line 34) this single capping unit is not a repeat unit and its phenyl end group is not divalent.

7.2 Document (28) discloses melt-stable aromatic polyetherketones comprising predominately the recurring structural unit



wherein each of x, m and n are 0 or 1, p is an integer from 1 to 4, n is 0 where x=1, and wherein when p is greater than 1, m is 1 and x is 0 (column 2, lines 29 to 41) and exhibiting an inherent viscosity of from 0.4 to 2.0 (column 4, lines 60 to 63). In order to fall within the claimed polymers the above recurring structural unit should be EEKEEK which would involve following impossible combination of parameters: p=1, x=0, m=1 and n=2. The specific polymer according to Example 2 relied upon emphatically by the Appellant does not lead to another conclusion; the polycondensation of 4,4'-diphenylether diacid chloride and 4,4'-diphenoxybenzene gives rise to a polymer with KEKEE as repeat unit which, when written several times, shows several EKE units. However, the remaining KE units would not correspond to any combination of units IV to VI according to Claim 4 of the patent-in-suit.

Nor can the arguments of transesterification be put forward, since this phenomenon does not occur to any signification extent with the polymers prepared by the electrophilic route used in document (28), as demonstrated by the Respondent by means of the NMR spectra filed on 4 August 1986 in the opposition procedure.

- 7.3 Summarizing, the specific embodiments encompassed in documents (9) and (28) cannot modify the basic repeat units of the polymers described therein in such a way that these polymers could correspond to the polyetherketones of repeat unit I as claimed in the patent-in-suit, so that novelty is acknowledged.

#### Inventive Step

8. The patent-in-suit relates to thermoplastic polyetherketone containing a majority of repeating units I and a

method for their preparation. Polymers based on the same recurrent units are known from document (7) which describes a broad class of aromatic polyethers with ketone and/or sulphone linkages (Tables III to IX) as well as the preparation thereof by the two-step nucleophilic process (page 2376, paragraph 4 to page 2378, paragraph 3). Polymers of repeat units I obtained from the disodium salt of hydroquinone and 4,4'-difluorobenzophenone are even explicitly mentioned in Tables VIII to IX. Unlike the polyethers prepared from aromatic compounds with nucleophilic substituents which tend to be non crystalline and not easily crystallizable by solvent or annealing techniques (page 2391, paragraph 3), the polymer of repeat unit I is listed in Table IX among the crystallizable polyethers and is, therefore, brittle (page 2391, paragraph 4). A further shortcoming is the extreme difficulty, or even impossibility, to obtain a polymer of acceptable molecular weight as a result of premature extensive crystallization (page 2378, paragraph 4).

9. In the light of this closest prior art, the technical problem underlying the patent-in-suit can thus be seen in providing a polymer of repeat unit I of high molecular weight and improved toughness. This is achieved by the operative features according to Claims 1 and 5 which schematically encompass the polycondensation of hydroquinone and 4,4'-difluorobenzophenone, optionally together with lower amounts of other starting compounds, under substantially anhydrous conditions and in presence of enough alkali metal carbonate or bicarbonate to yield the dimetal salt of hydroquinone, the alkali metal being selected from sodium carbonate and/or bicarbonate is excluded, and in presence of a diphenylsulphone solvent at a temperature between 150 and 400°C, the final temperature being sufficiently high to ensure an intrinsic viscosity

of the polymer of at least 0.7 (i.e. a reduced viscosity of at least 0.8).

In view of the results obtained in the Examples of the patent-in-suit the Board is satisfied that the above technical problem has been plausibly solved.

10. The first question which arises is whether toughness and high molecular weight are independent parameters, i.e. whether toughness, which the Respondent has repeatedly put forward as the major argument for inventive step, is really surprising as a result of the increased molecular weight. As it was conceded in the Affidavit of Dr. Staniland filed on 23 July 1984 (page 16, point 28), although one cannot anticipate that a given brittle polymer is capable of being produced as a tough polymer by merely increasing the molecular weight, the expert confronted with a brittle polymer would probably consider to increase the molecular weight in order to reduce brittleness. The Statement by Dr. Kwiatkowski together with the Annexes thereto filed on 3 November 1988 confirms that there is a close molecular weight-performance correlation for most polymer properties including toughness; this is particularly clear from the general diagram on page 45 of Polymer Chemistry by F.W. Billmeyer, 1957, published by Interscience Publishers, New York, which shows that the area of toughness tends to be an area of high molecular weight.

In fact, this relationship between toughness and molecular weight is only valid to a certain extent. As put forward by Professor Haward in his Affidavit filed on 23 July 1984, beyond a certain molecular weight the mechanical properties generally level off to a roughly constant plateau value and increase of the molecular weight above this plateau value has little further effect on the

properties. The relevant question regarding any particular polymer is therefore whether, when the plateau is reached, the polymer is tough or brittle. In practice, toughness of polymethacrylate and polystyrene, which are basically brittle polymers, is improved by techniques which do not involve increase of molecular weight (point 6).

Besides, Professor Haward demonstrated in his first Affidavit filed on 11 May 1983 that in some cases brittleness, thus toughness, may be related to crystallinity. Both bisphenol A polycarbonate and polyethylene terephthalate become brittle when they are caused to crystallize in an unstretched condition, and even high molecular weight polyethylene becomes progressively more brittle when crystallinity is raised beyond a certain point (point 13).

Further, experimental data based on variations of physical properties according to structural changes in the polymer main chain show that toughness is closely related to rigidity and density (Article "Poly(arylene ether sulphones) by polyetherification: 4. Physical properties in relation to molecular structure" by T.E. Attwood published in Polymer, 1977, Volume 18, pages 369 to 374, in particular, page 373, column 2). More specifically, progressive replacement of para repeat units by the corresponding ortho or meta repeat units results in a large loss in toughness accompanied by a significant increase in rigidity and density; toughness can thus be modified by the structural isomerism of the repeat units in the polymer main chain without any variation in molecular weight or molecular weight distribution.

Summarizing, although improved toughness may be achieved in some cases by merely increasing the molecular weight of a polymer, this cannot be regarded as a general solution,

nor as the only available alternative for a given polymer, thus in the present case.

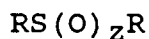
11. The process described in document (12), which is based on the nucleophilic route already used in document (7), is suitable for the preparation of high molecular weight aromatic polyethers and might thus have been considered first by the skilled man.
- 11.1 The method according to document (12) comprises contacting under substantially anhydrous conditions a dihydric phenol and a dihalobenzenoid compound having an inert electron withdrawing group in at least one of the positions ortho and para to the halogen atoms in presence of an unspecified alkali metal carbonate in a sulphoxide or sulphone reaction solvent (Claim 1), sodium and potassium being preferred mainly for cost reasons (page 6, lines 6 to 20).

Three features are essential to achieve the desired high molecular weights.

The first one is a structural requirement for the dihalobenzenoid compound (page 14, line 9 to page 15, line 17). When the halogen atoms, preferably fluorine and chlorine, are attached to different aromatic nuclei of a polynuclear dihalobenzenoid compound, there should be a strong activating electron withdrawing group between these nuclei and the two halogen atoms should be in ortho or para position thereto. The activating effect of the electron withdrawing group which functions through the resonance of the aromatic structure is measured by the sigma\* value which should be positive, zero corresponding to no electron withdrawing at all, and above +0.7 being regarded as high enough to activate the displacement of the two halogen atoms and thereby promote the

polycondensation; the carbonyl group is explicitly cited as appropriate for this purpose. This means that, although difluorobenzophenone is not mentioned as such in this document, the preparation of aromatic polyetherketones is clearly encompassed in the teaching thereof.

The second feature is the solvent (page 4, line 1 to page 5, line 14) which has following generic formula



where each R represents a monovalent lower hydrocarbon group free of aliphatic unsaturation on the alpha carbon atoms or, when connected together, represents a divalent alkylene group and z is an integer from 1 to 2 inclusive. Although the R groups may be aryl groups, especially phenyl groups, and diphenylsulphone is even quoted as suitable solvent, preference is given to sulfolane because it is a solvent for the widest variety of reactants as well as for the resulting polymer of the reaction.

The third feature is the elimination of water which may be present in the reactants and solvents charged to the reaction mass and/or liberated during the decomposition of unstable alkali metal bicarbonate (page 2, line 28 to page 3, line 13; page 6, lines 6 to 11; page 7, line 1 to page 8, line 33). The removal of water is not necessary to produce a polymer, but it is preferred in order to insure the yield of high molecular weight polymers and to avoid the formation of phenolic species as by-products of hydrolysis of unreacted dihalobenzenoid compounds. Substantially anhydrous conditions are achieved by the use of an azeotrope former, preferably in excess of that needed to azeotrope off the water, with the balance acting as a cosolvent for the polymer during polycondensation. The beneficial effect of the presence of an azeotrope

former on the molecular weight of the polymer is evident from a comparison between Examples 1 and 2; whereas the polyether obtained in presence of toluene as azeotrope former exhibits a reduced viscosity of 0.46 (Example 1), only a reduced viscosity of 0.27 can be obtained when no toluene is added and no water of reaction is removed (Example 2).

In summary, the teaching of document (12), which is suitable for the preparation of polymers derived from hydroquinone (page 11, line 31), would thus invite the skilled man to operate in presence of solvent systems comprising an aliphatic sulphone/sulphoxide compound as main solvent and an azeotrope former as cosolvent and in presence of sodium or potassium carbonate.

11.2 In fact, this combination of features would not provide the solution to the above defined problem or may not even be considered by the skilled man.

11.2.1 First of all, it is essential to appreciate that, although it is generally referred in document (12) to the preparation of high molecular weight polymers, polymers with the same repeat units have a higher molecular weight when produced by the process according to document (7) even when the solvent is the same. According to Example 1 of document (12), the polymer obtained from bisphenol A and 4,4'-dichlorodiphenylsulphone in DMSO has a reduced viscosity of 0.46; according to Table III (page 2382) of document (7), it exhibits a reduced viscosity of 1.4. Likewise the polymer obtained from 4,4'-dihydroxydiphenylsulphone and 4,4'-dichlorodiphenylsulphone in sulpholane according to Examples 11 to 13 of document (12) have reduced viscosities ranging between 0.81 and presumably 0.35 (the value actually disclosed, namely 70.35, is obviously a misprint), whereas the same starting compounds



lead to a polymer with a reduced viscosity of 0.97 in document (7) (page 2379, Table II). Thus, simple considerations of molecular weight already are not in favour of the carbonate process as disclosed in document (12).

11.2.2 The second point to consider is the choice of the alkali metal carbonate in document (12). Under most comparable conditions (Examples 4 to 6) the reduced viscosity of the polymer obtained by using potassium carbonate is 0.80 (Example 4) and 0.75 (Example 6) whereas it is 0.98 by using sodium carbonate (Example 5); similarly (Examples 11 and 12), the polymer obtained by using potassium carbonate according to Example 11 has a reduced viscosity of 0.81 whereas the use of sodium carbonate yields a polymer with a reduced viscosity of 0.74 (Example 12). These comparative data would thus suggest that sodium and potassium carbonate are equally suitable for the preparation of polyethers by the nucleophilic route.

By contrast, as required in the patent-in-suit, the use of sodium carbonate alone is excluded, since it is not appropriate for the polycondensation of hydroquinone and 4,4'-difluorobenzophenone in presence of diphenylsulphone, as apparent from Examples 17 to 19 of not prepublished document (22). When the reaction is carried out in presence of anhydrous sodium carbonate, the reduced viscosity of the resulting polyetherketone is 0.60 and a film, compression moulded from the polymer at 400°C, is brittle and dark grey in color (Example 17); in presence of potassium carbonate (Example 18) or of a mixture thereof with sodium carbonate (Example 19) one obtains polymers with a reduced viscosity of 1.55 and tough films with improved color characteristics.

This means that the disclosure of document (12) regarding the metal carbonate to be used does not go beyond the teaching of document (7) and therefore does not suggest the specific choices made by the Respondent.

11.2.3 As far as the solvent is concerned, document (12) merely confirms thus (page 4, line 1 to page 5, line 14) the preference already given in document (7) for aliphatic sulphones, especially sulpholane (page 2379, paragraphs 3 and 4). More specifically, according to Table I of document (7), polymers obtained from the sodium salt of bisphenol A exhibit a reduced viscosity of 1.0 when the polycondensation is carried out at 160 to 165°C during one hour in DMSO whereas the use of diphenylsulphone leads to a polymer with a reduced viscosity of only 0.4 after 11 hours at 230 to 250°C. Thus, the prior art does not invite to use aromatic sulphones as solvent.

As stated above, it is advantageous in the carbonate process taught in document (12) not only to use an azeotrope former, but to use an excess thereof which acts as a cosolvent for the polymer. This resolvatation of the polymer has a beneficial influence on the molecular weight of the polymer, since high molecular weights are only possible when the growing polymer chain remains dissolved in the solvent (page 9, line 30 to page 10, line 7). This is a clear incentive to use the cosolvent technique in order to overcome the difficulties due to premature crystallization mentioned in document (7). However, as demonstrated by means of a comparative example in the Affidavit of Dr. Rose filed on 11 May 1983, the cosolvent technique does not bring the expected improvement in the case of the reaction of hydroquinone and 4,4'-difluorobenzophenone according to the process of document (7). When carried out at 235°C in presence of sulpholane as solvent and xylene as azeotrope former, the

polycondensation yields a polymer having a reduced viscosity of 0.17 and a film compression moulded from it is brittle (page 3, paragraph 3 to page 4, paragraph 1); the addition of diphenyl ether as cosolvent after the reaction mixture has been maintained at 235°C during 2 hours does neither improve the reduced viscosity of the polymer, nor reduce the brittleness of the film (page 5, paragraphs 2 to 5).

Thus, regarding the choice of the solvent(s), the skilled man does not obtain from document (12) any information useful for the solution of the above defined problem.

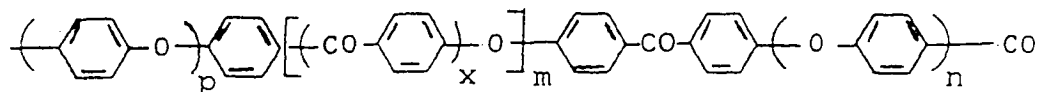
11.2.4 The only clear teaching in the prior art concerns the choice of the halogen atom in the dihalobenzenoid compound. Besides the general statement in document (12) that fluorine compounds are preferred for their fast reactivity and chlorine compounds for their inexpensiveness (page 23, lines 22 to 25), it is explicitly demonstrated in Table IV, page 2386, of document (7) that difluorobenzophenone yields polyetherketones of much higher molecular weight than dichlorobenzophenone; whereas the chloro derivative gives rise to a polymer having a reduced viscosity of 0.16 after 18 hours, a reduced viscosity of 1.0 is already obtained after 0.5 hour with the fluoro derivative.

In this respect, thus, document (12) does not add anything to the teaching of document (7).

11.2.5 In conclusion, the carbonate process according to document (12) does not teach the skilled man how to prepare polyetherketones of high molecular weight, let alone tough polyetherketones of high molecular weight, derived from hydroquinone and 4,4'-difluorobenzophenone and, therefore, cannot provide the solution to the above defined problem.

12. This would thus lead the skilled man to abandon the nucleophilic route for the electrophilic route which has proved to be suitable in document (28) for the preparation of polyetherketones of high molecular weight.

12.1 As already stated in point 7.2, document (28) describes substantially linear crystalline polymers with inherent viscosity greater than 0.4 and of following repeat unit



wherein the parameters m, n, p and x have the meaning given above. The presence of diphenyl ether sub-units is the essential feature of these polymers.

The method for the preparation thereof described in document (28) must be regarded as an attempt to overcome, by a judicious choice of reactants and process conditions, some of the prior art difficulties caused by the unstability of diphenyl ether in the HF/BF<sub>3</sub> system in the preparation of polyetherketones containing this sub-unit (column 2, lines 10 to 26). This is achieved by polycondensing the diphenyl ether compound and the electrophilic dichloride reactant in sufficient anhydrous fluorhydric acid to form at 0°C a 10% weight solution. At -20°C to -10°C, after first allowing all chlorhydric acid to evolve, boron trifluoride is added under 30 psi pressure, the reaction allowed to proceed for about 6 hours and the polycondensation mixture then diluted with sulphurous acid anydride or additional fluorhydric acid to form a solution containing about 5% weight solids; after recovery by spray drying or precipitation into water or methanol, fluorine and boron content of the resulting

polymer is reduced by water wash and dried (column 5, lines 1 to 17). It is clear that these specific conditions are tailored for the preparation of polyetherketones containing diphenyl ether sub-units and that they cannot lead to the process features according to the patent-in-suit.

- 12.2 Although the parameters p and n are such that the basic recurrent unit may contain several diphenyl ether sub-units and thereby exhibit a high E:K ratio and although the specific ratio of 2:1 may even be obtained for particular combinations of the parameters, namely  $m=1, x=0, n=0, p=3$  and  $m=1, x=0, n=1, p=2$  corresponding respectively to the repeat units EEEEKK and EEEKEK, the polymers actually exemplified all have a E:K ratio lower than 2:1. The five polymers listed in Table I, which represent the preferred embodiments and therefore the preferred combinations of parameters, have E:K ratios of respectively 2:2, 3:2, 2:3, 1:2 and 2:2.

From Table II it appears that the melting point of these polymers increases as the E:K ratio decreases which conversely means that the higher ratio of 2:1 would correspond to a polymer of even lower melting point. This had already been observed in Table IX of document (7) where the polymer with a E:K ratio of 2:1 has a higher melting point than the polymer with a E:K ratio of 3:1.

The polymers according to document (28) are particularly suitable for applications in the field of electrical insulation (column 8, lines 29 to 55). For this purpose, crystalline polymers with a high melting point between 340 and 404°C, especially in the upper range, and with more carbonyl moieties than ether linkages, thus with low E:K ratios, are particularly preferred.

- 12.3 In conclusion, the electrophilic route as described in document (28) is not a promising teaching, since neither the operative features which take the presence of specific structural sub-units in the nucleophilic reactant into account, nor the low E:K ratios required for the high crystallinity of the polyetherketones, are compatible with the problem to be solved.
13. The solution chosen by the Respondent is a selection within the carbonate process disclosed in document (12). More specifically, this solution is a combination of operative features wherein neither the choice of an aromatic sulphone as solvent, nor the deletion of the azeotrope former, nor the absence of cosolvent, nor the exclusion of sodium carbonate can be regarded as obvious in view of the specific difficulties noted in document (22) caused by the polycondensation of hydroquinone and 4,4'-difluorobenzophenone; their combination must thus be inventive. The return to the use of a basic process considered superseded is additionally regarded as an indication of inventive step, as the Board already appreciated in a similar situation (see T 229/85 dated 27 October 1986 published in OJ EPO 1987, 237, point 7). For these reasons the process claimed in Claim 5 must be regarded as inventive.
14. The specific combination of p-dioxyphenylene and benzophenone sub-units confers to the claimed polymers a balance of properties which makes them not only superior in many respects to other aromatic polyetherketones, but even comparable to polyarylene polymers known as Stilan from document (10) and regarded as the outstanding polymer in the field (Affidavit of Dr. Staniland filed on 23 July 1984, points 9 and 24 to 26).

The claimed polymers exhibit exceptional environmental resistance both to chemicals and solvents; apart from the strong acids, they do not dissolve in any solvent at normal temperatures. If they do catch fire, the products of combustion, which are principally carbon dioxide and water, have low toxicity and low corrosivity as well as low level of smokes. Further, their properties afford highly specific applications, such as low friction material in bearing formulations in the aerospace industry or manufacture of bi-axially oriented films, which are not suggested in the prior art cited.

The major advantage of the claimed polymers is their low melting point (334°C). This value is lower than the melting points mentioned for closely related aromatic polyetherketones in Table II of document (28) which all range between 340 and 402°C; it is lower as well than the value of 370°C indicated for Stilan polymers in the brochure "Stilan Insulated Wire - An extension of Technology from Aircraft Applications to Metropolitan Railway Systems" page 1, column 2, line 2 which is part of document (10). This difference represents a marked advantage in favour of the claimed polymers in extrusion and injection moulding processes.

Further, toughness, which cannot be regarded as a self-evident property for the reasons given above, contributes to the inventiveness of the products according to Claim 1.

15. Claims 1 and 5 being acceptable, the same applies to the product-by-process Claims 2 to 4 and to the process Claims 6 to 11 which are merely preferred embodiments of these two independent claims and are thus supported by their patentability.

16. As stated above in point 12.2, the polyetherketones described in document (28) to be used in the field of electrical insulation should be highly crystalline polymers with a high melting point, preferably on the order of 400°C or higher, and a low E:K ratio, in practice between 3:2 and 1:2. That excellent insulating properties can be achieved with a polyetherketone having a much higher E:K ratio is regarded as surprising and confers an inventive step to Claim 12 concerning electrical insulation.

Order

For these reasons, it is decided that:

1. The decision of the Opposition Division is set aside.
2. The case is remitted to the Opposition Division with an order to maintain the patent with description and claims as in the main request.

The Registrar:

The Chairman:

F. Klein

K. Jahn