

Veröffentlichung im Amtsblatt	J/Nein
Publication in the Official Journal	Yes/No
Publication au Journal Officiel	Oui/Non



Aktenzeichen / Case Number / N^o du recours : T 154/87 - 3.2.1

Anmeldenummer / Filing No / N^o de la demande : 81 901 788.0

Veröffentlichungs-Nr. / Publication No / N^o de la publication : 0 056 418

Bezeichnung der Erfindung: Polyphenylene Sulfide Filament Sheet and
Title of invention: Process for its Production
Titre de l'invention :

Klassifikation / Classification / Classement : D04H 3/00, D04H 3/12, D04H 3/10

ENTSCHEIDUNG / DECISION

vom / of / du 29 June 1989

Anmelder / Applicant / Demandeur :

Patentinhaber / Proprietor of the patent /
Titulaire du brevet :

Toray Industries Inc.

Einsprechender / Opponent / Opposant :

Bayer AG, Leverkusen

Stichwort / Headword / Référence :

EPÜ / EPC / CBE Article 56 EPC

Schlagwort / Keyword / Mot clé :

Inventive step (yes) - surprising effect
no precondition

Leitsatz / Headnote / Sommaire

Europäisches
Patentamt

Beschwerdekammern

European Patent
Office

Boards of Appeal

Office européen
des brevets

Chambres de recours



Case Number : T 154/87 - 3.2.1

D E C I S I O N
of the Technical Board of Appeal 3.2.1
of 29 June 1989

Appellant :
(Proprietor of the patent) Toray Industries Inc.
2, Nihonbashi-Muromachi 2-chome
Chuo-Ku, Tokyo 103 (JP)

Representative :
Kador & Partner
Corneliusstraße 15
D-8000 München 5 (DE)

Respondent :
(Opponent) Bayer AG, Leverkusen
Konzernverwaltung RP
Patentabteilung
Bayerwerk
D-5090 Leverkusen (DE)

Representative :

Decision under appeal : Decision of Opposition Division of the European Patent Office dated 21 January 1987 and posted 26 February 1987 revoking European patent No. 0 056 418 pursuant to Article 102(1) EPC.

Composition of the Board :

Chairman : P. Delbecque

Members : F. Gumbel

F. Benussi

Summary of Facts and Submissions

- I. European patent No. 0 056 418 was granted on 15 August 1984 with 15 claims on the basis of European patent application No. 81 901 788.0, filed on 24 June 1981.
- II. The patent was opposed in due time and form on the ground of lack of inventive step in the light of the prior art reflected by the documents

- (1) US-A-3 912 695
- (2) US-A-3 898 204
- (3) US-A-4 098 776
- (4) US-A-4 020 054
- (5) US-A-4 199 321
- (6) US-A-4 029 639
- (7) US-A-4 115 562
- (8) US-A-3 338 992

After expiry of the opposition period two further documents were cited by the Opponent, namely:

- (9) Ind. Eng. Chem. Prod. Res. Dev., Vol. 18, 1979, page 252, and
- (10) US-A-3 919 177

- III. The Opposition Division revoked the patent at the end of oral proceedings held on 21 January 1987. The written decision was given on 26 February 1987. The reason for this decision was that the patent in suit in the then valid version of the claims did not contain inventive subject-matter having regard to the state of the art reflected substantially by documents (8), (2) and (9). In addition, the Opposition Division took into account the

documents (4), (7) and (10) when stating lack of inventive step.

- IV. The Appellant (Proprietor of the patent) filed an appeal against this decision on 13 April 1987, paying the appeal fee at the same time. The Statement of Grounds of Appeal was filed on 23 June 1987.
- V. In a communication dated 26 September 1988 the Board set out its provisional opinion about formal aspects concerning the claims subsisting at that time and also raised doubts about the meaning and relevance of the formula contained in both independent claims. Reference was made to (12) "Encyclopedia of Polymer Science and Technology", Vol. 10, 1969, pages 655 to 658.
- VI. Oral proceedings were held on 29 June 1989 during which both parties took the opportunity to develop their lines of argument. A new set of Claims 1 to 8 and an adapted patent description were submitted by the Appellant during these proceedings.

The arguments set out by the Appellant in his written submissions and during the oral proceedings can be summarised as follows:

- The correct starting point for assessing inventive step is the state of the art known from documents (1) and (2) rather than document (8) chosen by the Opposition Division in the impugned decision, since this latter document does not mention PPS-filaments at all, which in fact were not available at the application date of document (8). Documents (1) and (2) on the other hand deal inter alia with non-woven fabrics of melt-spun PPS-filaments. However the filaments used with those known

sheets have relatively high denier values and are melt spun at low speeds.

- The object underlying the present invention, i.e. the production of fibrous sheets of PPS having high strength and uniform quality and providing high bunching property and also low shrinkage under high temperatures, is not addressed or solved in the available prior art.
- In order to achieve this object the combination of all features specified in the respective independent claims is necessary and it is this combination of features for which protection is sought. Hence, it does not matter if one or the other of those features can be derived in a different context from the cited documents.
- The formula indicated in both independent claims actually defines a selection of material in the sense that the PPS used in the present invention is of a substantially linear character with a relatively low degree of branching and cross-linking. Only this type of PPS can be spun at the high spinning speeds required by the invention.
- Neither this selection of material nor the fineness of the filaments, the high spinning speed and the felting by interlocking as claimed, can be derived from the available prior art together with the production of a PPS-sheet.

In contesting these arguments, the Respondent substantially made the following points:

- The polymer used with the sheet of the patent in suit is not clearly defined; in particular the formula indicated in the independent claims applies to all spinnable kinds

of PPS and therefore does not really provide a selection of material which could contribute anything to the inventiveness of the sheet and process specified in these claims. The other features of these claims are also of a very broad and general character and do therefore not define subject-matter being clearly distinguished from the known sheet and the known process, respectively.

- The properties of PPS, such as heat resistance, electrical insulating effect, chemical resistance and strength were well-known to the skilled person before the application of the present patent. Consequently, no surprising effect is achieved by the sheet of Claim 1.
- From documents (1) or (2) and (11) US-A-3 354 129 referred to therein, it was known that PPS-filaments can be produced by a spinning process in a relatively tough and non-brittle quality. Hence, there could not have been any mental barrier against spinning such filaments with high spinning speeds and felting the filaments by interlocking.
- Moreover, the skilled man is generally taught by document (8) that sheets of polymer filaments having a fineness within the range as claimed can be produced by spinning those filaments at such high spinning speeds and binding these randomly dispersed and accumulated filaments by needling techniques, i.e. by interlocking. A skilled man would have easily applied this general teaching with the specific polymer used in the present case, i.e. PPS, from which he knew that it is also spinnable into thin filaments.

VII. The Appellant requested that the decision under appeal be set aside and that the patent be maintained in the form as submitted during the oral proceedings.

The Respondent requested that the appeal be dismissed.

VIII: Subsisting independent Claims 1 and 3 read as follows:

"1. A sheet of polyphenylene sulfide (referred to as PPS hereinafter) filaments which comprises randomly dispersed and accumulated PPS-filaments, each having a fineness of 0.1 to 15 denier, wherein said PPS-polymer has "n" which is represented by $0.9 < n < 3.0$, n being represented by the following formula

$$\dot{\gamma} = \frac{1}{\mu} T^n$$

wherein $\dot{\gamma}$ is shear rate, T is shear force and μ is apparent viscosity, the filaments having a shrinkage of 5 to 40% at 140°C, the filaments being spun with a spinning speed of 3 000 m/min or higher and felted by interlocking.

3. A process for producing a sheet of polyphenylene sulfide (referred to as PPS hereinafter) filaments which comprises extruding a PPS-polymer from a plurality of small holes at a temperature 20 to 85°C higher than the melting point of the PPS-polymer, drawing apart the extrudate from the small holes at a rate greater than 3 000 m/min by a high-velocity air stream, simultaneously causing the resulting filaments to be opened by electrostatic charge, collecting the opened filaments on a plane, which filaments are having a fineness of 0.1 to 15 denier, and a shrinkage of 5 to 40% at 140°C and interlocking the collected filaments, wherein said PPS-polymer has "n"

which is represented by $0.9 < n < 0.3$, n being represented by the following formula:

$$\dot{r} = \frac{1}{\mu} T^n$$

wherein r is shear rate, T is shear force and μ is apparent viscosity.

Reasons for the Decision

1. The appeal complies with Articles 106 to 108 and Rule 64 EPC; it is admissible.
2. No formal objections arise with the subsisting claims.
 - 2.1 Claims 1 and 3 have clearly been limited in respect of granted Claims 1 and 7 by the introduction of the features of granted Claims 3, 6 and 8 and by a restriction of the range of the spinning speed and therefore meet the requirement of Article 123(3) EPC. Since the granted claims correspond to the respective original claims and since the spinning speed of at least 3 000 m/min is disclosed in the original description, it follows from the foregoing that Article 123(2) EPC is not offended either with respect to the independent claims. Dependent Claims 2 and 4 to 8 have their counterparts in the original and granted Claims 2, 8, 10 and 12 to 14 and are therefore likewise covered by the original disclosure.
 - 2.2 As to the fact that the independent claims are not drafted in the two-part form the Board is not convinced that this form would be appropriate in the present case, since - as will be seen in the following observations - there appears

to be no single piece of prior art on the basis of which a reasonable preamble of such claims could be worded. At least there appears to be no necessity for introducing the two-part form at this late stage of the proceedings in a case in which the suitability of this form could be discussed (Rule 29(1)(a) EPC).

2.3 In contrast to the Respondent's opinion the Board considers that both independent claims clearly define the matter for which protection is sought and therefore also meet the requirement of Article 84 EPC. It may be true that the ranges claimed for the non-Newtonian constant "n" and also for the allowable shrinkage apply to a broad variety of PPS-polymers having different viscosities, however this does not mean that the claims are not clear. There was no objection from the Respondent's side that a skilled person could have difficulties in producing a sheet with the features of Claim 1 or in carrying out the process of Claim 3 because of insufficient or ambiguous information given by those claims.

3. Regarding patentability it follows immediately from the comparison of the subject-matter of both independent claims with each individual prior art document that this subject-matter is novel. None of these available documents discloses a PPS-sheet comprising filaments having a fineness as claimed and being spun at speeds of 3 000 m/min and higher, nor do they show or describe the production of such sheet by interlocking the randomly dispersed filaments into a felted structure. Since novelty has never been disputed, this question need not be substantiated in more detail.

4. What has been disputed by the Respondent and by the impugned decision is the existence of an inventive step with the subject-matter of Claims 1 and 3. In this regard

the examination by the Board has led to the following result:

- 4.1 Concurrent with the Appellant the Board considers that the correct starting point for the assessment of inventive step is the prior art reflected by documents (1) or (2) and (11), which latter document is included in the disclosure of (1) and (2) by reference. From these documents it is known to produce inter alia non-woven fabrics, i.e. sheets of randomly dispersed filaments somehow formed into a coherent fleece-like sheet from PPS-polymer filaments obtained by melt spinning. However, the sheets produced according to the teaching of this prior art suffered from drawbacks such as breakage and non-uniform quality of the filaments and lack of bunching property (see page 2, lines 10 to 24 of the patent specification).
- 4.2 As follows from the drawbacks and problems set forth on page 2, lines 12 to 24 of the patent specification it is not the object of the invention to produce a fibrous sheet of any material having superior properties in heat resistance, electrical insulation and so on, as stated in the impugned decision, but rather the object underlying the invention is to provide a sheet specifically on the basis of PPS, which overcomes the problems previously encountered with such sheets and which in particular, has high strength and a uniform quality, low heat shrinkage and good bunching property.
- 4.3 It is true, as contended by the Appellant, that this object is nowhere addressed in the available prior art. Hence, the skilled man searching for a solution to the existing problems could not derive an immediate teaching from the prior art as to how such problems could be solved.

4.4 Regarding the different features indicated in Claim 1 the Board does not share the Respondent's opinion according to which the range of "n" between 0.9 and 3.0, "n" being represented by the formula in the claim, does not provide a selection of material but rather applies to the whole range of suitable PPS-polymers. It is clearly stated in the patent specification that this range of "n" represents a substantially linear PPS-polymer of high polymerisation degree (see page 3, lines 45 to 47). This was also acknowledged by the first instance, as can be seen from their statements under point 4, last paragraph of the impugned decision. The Respondent did not provide any evidence in support of his contention that the claimed range of "n" would also cover non-linear PPS-polymers, i.e. PPS polymers having a relatively high degree of cross-linking and branching, which may be obtained by an additional curing step, as mentioned in column 4, lines 13 to 29 of document (1) and as described in the examples thereof (the same disclosure is contained in document (2)). Hence, in the Board's judgment the range of "n" indicated in Claim 1 provides a selection of a specific kind of PPS polymer (linear, highly polymerised PPS) among a wide spectrum of available PPS polymers suitable for melt spinning into filaments (see documents (1) and (2)).

Unlike the first instance, the Board considers that this selection contributes to the inventive step involved by the subject-matter of Claim 1. Although it appears that the PPS polymer described in documents (9) and (10) would fall within the claimed range of "n", which possibility could not be excluded by the Appellant (see page 3, first paragraph of the Appellant's letter dated 26 January 1989), this does not mean that the claimed selection is without any inventive merit, even if one takes into account that the type of PPS described in documents (9)

and (10) is shown to be of good spinnability without necessitating a prior curing (see e.g. Example XX of (10) including the values of sample 3 in Table I). There is, however, no suggestion in those documents in the sense that it is the linearity together with the high degree of polymerisation as represented by the claimed range of "n" which makes the PPS-polymer particularly suitable for melt spinning very fine and strong filaments at an extremely high spinning speed.

- 4.5 As to the other features indicated in Claim 1 it is firstly to be noted that none of the documents dealing with non-woven fabrics or sheets comprising randomly dispersed filaments (in contrast to woven fabrics, where yarns composed of a plurality of filaments are used) discloses or suggests any of these features. According to documents (1) and (2) relatively thick filaments (see 193 denier in Table II and 93 denier in Table III before drawing) are melt spun with relatively low spinning speeds (maximum 415 ft/min in Table III). In document (3) melt spinning at speeds of 30 ft/min is recommended and filaments of 190 denier and more are obtained (see column 3, line 13 and Table II).

Documents (4) to (7) describe the production of yarn or strands composed of a multiplicity of filaments having a fineness falling within the range indicated in present Claim 1 (see e.g. the 68 filament yarn with an average denier of 350-400 according to Example I of document (5)). This only shows that it was possible to produce such fine filaments of PPS by melt spinning. It does, however, not suggest making use of such fine filaments left as monofilaments for the production of a fleece-like sheet, requiring that they are strong enough to be felted by interlocking. Furthermore, no suggestion arises from documents (4) to (7) as to the importance of the high

spinning speed as claimed, to the increase of strength of such fine filaments.

As already stated above, the PPS-polymers described in documents (10) and (9) appear to relate to the same or at least to a similar type of polymer as it is used with the present invention. This assumption is based on the fact that in both cases the PPS is prepared in a very similar way by reacting the same materials as can be seen from a comparison of the preparation of PPS according to Example 1 of the invention with e.g. Example XVII of document (10). As follows from Example XX (column 16 and Table I, columns 17/18) the above polymer was melt-spun without prior curing into monofilaments of 20 denier having superior strength properties (tenacity of 4.3 g/d which is in fact higher than the values given in Table I of the patent in suit). However the above minimum fineness of the filaments is still beyond the range defined in present Claim 1 and, moreover, there is no suggestion as to carrying out the spinning process with a spinning speed of 3 000 m/min and higher nor is there any hint that the filaments thus obtained could be applied for the production of a fleece-like sheet by interlocking those filaments.

Document (8) mostly relied on by the first instance as support of their negative assessment as to the question of inventive step and also stressed by the Respondent, does not deal with the specific polymer concerned in the present case, i.e. with PPS. Moreover, a skilled person would never imply PPS within the disclosure of polymers addressed in this document since he knows that it was only in 1967, i.e. after the application date of document (8), that a new process for making spinnable PPS was discovered, as disclosed in document (11). Since the problems and difficulties encountered with PPS and

relating to its tendency to brittleness and gelation are not mentioned in this document and are not likely to arise with the polymers listed therein it appears doubtful whether the skilled person would even take this document into close consideration when searching for a solution to the given problems arising with the production of a fleece-like sheet from PPS and, even if so, whether he would apply features known from this document, such as the fineness of the fibres (column 3, line 50), the high spinning speed (column 6, line 64), the random dispersal of fibres (column 4, lines 9/10) and felting of the sheet by interlocking (see column 15, lines 47/48), when producing a sheet of PPS.

In any case, document (8) although mentioning ranges of filament fineness, spinning speeds and also the applicability of needling techniques for forming a non-woven sheet or web does not give any suggestion in the direction of the synergetic effect aimed at and achieved to the Board's conviction with the combination of features specified in present Claim 1. In particular, this document recommends spinning speeds in the broad range from 500 yards to about 6 000 yards per minute without mentioning any relationship between fineness of the filaments, spinning speed and desired strength of the filament. Hence, the Board does not see, how the skilled person could have derived from this general disclosure the idea of drawing the fine filaments at the very high spinning speeds of 3 000 m/min and higher in order to arrive at the necessary strength and low shrinkage of the filaments and thus enabling them to be felted by interlocking (see page 3, lines 58 to 62 of the present patent specification).

4.6 Summarising, the Board comes to the conclusion that the finding of the combination of features indicated in

Claim 1 in order to provide a sheet of PPS of superior strength, uniformity and bunching properties in accordance with the object underlying the present invention, was not obvious in the light of the available prior art. The same applies mutatis mutandis to the process of Claim 3 relating to the same inventive concept and comprising all the features specified in Claim 1.

- 4.7 Regarding the Respondent's argument according to which the independent claims do not define inventive subject-matter because the sheet of Claim 1 does not provide any surprising effect, the Board considers that this matter need not be investigated in detail, since the achievement of a surprising effect is no precondition for the existence of an inventive step. All that is necessary for a positive assessment of inventive step is to ascertain that the respective subject-matter could not be derived in an obvious manner from the available prior art (Art. 56 EPC). This has been developed above for the subject-matter of Claims 1 and 3. The Board is, moreover, convinced that the sheet of Claim 1 is advantageous over the sheets produced according to the prior art (documents (1) and (2)) concerning strength, uniform qualities and bunching properties. Certainly, there is no surprising effect concerning the fact that this sheet has good thermal and electrical insulating properties, as these qualities relating to the use of PPS polymer filaments were well-known prior to the application of the present patent (see document (12), page 658).

Moreover, it is not relevant whether or not a skilled man starting from the prior art reflected by documents (1) or (2) in combination with (11) had to overcome a mental barrier against the idea of spinning PPS polymer melt at the high speed claimed in present Claim 1 as long as there

is no positive teaching derivable from these documents or from any other available piece of prior art to go in this direction in order to solve the existing problems.

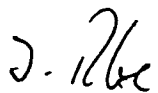
5. Dependent Claims 2 and 4 to 8 relate to particular embodiments of the invention according to their respective independent claims and are therefore likewise maintainable.
6. The description has been adapted to the scope of the subsisting claims and is considered to meet the requirements of Rule 27 EPC.

Order

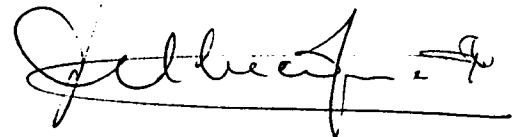
For these reasons, it is decided that:

1. The decision of the Opposition Division is set aside.
2. The patent is maintained in amended form with Claims 1 to 8 and the description as submitted during the oral proceedings.

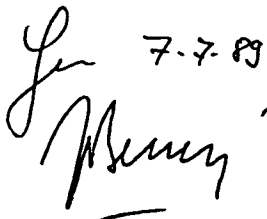
The Registrar:


J. Rückerl

The Chairman:


P. Delbecque

02329


7.7.89