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**DECISION**  
of 5 February 1999

**Case Number:** T 0248/95 - 3.2.5

**Application Number:** 85102788.8

**Publication Number:** 0156234

**IPC:** D04H 3/16

**Language of the proceedings:** EN

**Title of invention:**

Heat resistant non-woven fabric having a high elongation at break

**Patentee:**

Asahi Kasei Kogyo Kabushiki Kaisha

**Opponent:**

Hoechst AG

**Headword:**

-

**Relevant legal provisions:**

EPC Art. 54, 56, 69(1)

**Keyword:**

"Novelty (yes)"

"Inventive step (yes)"

**Decisions cited:**

-

**Catchword:**

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Case Number: T 0248/95 - 3.2.5

**D E C I S I O N**  
of the Technical Board of Appeal 3.2.5  
of 5 February 1999

**Appellant:** Hoechst AG  
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**Decision under appeal:** Interlocutory decision of the Opposition Division  
of the European Patent Office posted 27 January  
1995 concerning maintenance of the European  
patent No. 0 156 234 in amended form.

**Composition of the Board:**

**Chairman:** H. Ostertag  
**Members:** M. Ceyte  
J.-C. De Preter

## Summary of Facts and Submissions

- I. The Respondent is proprietor of European patent No. 0 156 234 (application No. 85 102 788.2).
- II. The patent was opposed by the Appellant on the grounds of insufficiency of disclosure and lack of patentability. The following state of the art was i.a. relied upon:

D1: DE-B-1 560 797,

D2: EP-A-0 056 963.

- III. By an interlocutory decision posted on 27 January 1995 the Opposition Division maintained the patent in amended form.

Amended Claims 1, 6 and 12 read as follows:

- "1. A nonwoven sheet composed of polyethylene terephthalate filaments, wherein the filaments have an elongation at breakage of at least 100% and a shrinkage in boiling water of at least 15%, the filament section is a circular section having a radius R, and the average refractive index  $n_{\parallel}(0)$  of the central portion of the filament section and the average refractive index  $n_{\parallel}(0.8)$  of the portion apart by 0.8R from the center satisfy the following requirements:

$$1.580 \leq n_{\parallel}(0) \leq 1.640 \text{ and } [n_{\parallel}(0.8) - n_{\parallel}(0)] \geq 6 \times 10^{-3}$$

and

the distribution of a partial average refractive index is symmetrical about the center of a filament section."

"6. A nonwoven sheet composed of polyethylene terephthalate filaments partially heat-press-bonded to one another, wherein the heat shrinkage at 150°C is at most 5% and the elongation at breakage at 150°C is at least 70%, and wherein the filaments have a circular section having a radius R, and the average refractive index  $n_{\parallel}(0)$  of the central portion of the filament section and the average refractive index  $n_{\parallel}(0.8)$  of the portion apart by 0.8R from the center satisfy the following requirements:

$$1.600 \leq n_{\parallel}(0) \leq 1.670 \text{ and } [n_{\parallel}(0.8) - n_{\parallel}(0)] \geq 5 \times 10^{-3}$$

and

the distribution of said partial average refractive index is symmetrical about the center of said filament section."

"12. A nonwoven sheet composed of polyethylene terephthalate filaments mechanically interlaced with one another by needle punching, wherein the heat shrinkage at 150°C is at most 5%, the filament density is such that the ratio of caught particles having a size larger than 15  $\mu\text{m}$  is at least 80%, and the elastic recovery is at least 50%, and wherein the filaments have a circular section having a radius R, and the average refractive index  $n_{\parallel}(0)$  of the central portion of the filament section and the average refractive index  $n_{\parallel}(0.8)$  of the portion apart by 0.8R from the center satisfy the following requirements

$$1.600 \leq n_{\parallel}(0) \leq 1.670 \text{ and } [n_{\parallel}(0.8) - n_{\parallel}(0)] \geq 5 \times 10^{-3}$$

and

the distribution of said partial average refractive index is symmetrical about the center of said filament section.

IV. On 22 March 1995 the Appellant (Opponent) lodged an appeal against this decision, with the appeal fee being paid at the same time. The Statement of Grounds of Appeal was filed on 29 May 1995.

V. Oral proceedings were held on 5 February 1999.

The Appellant requested that the decision under appeal be set aside and the patent be revoked in its entirety.

In support of this request, he essentially made the following submissions:

- (i) According to the patent in suit, even if an highly oriented polyethylene terephthalate filament possesses a good heat resistance, it has a low elongation at break. Therefore, a non-woven sheet made of this kind of fibres cannot be subjected to a post processing such as deep drawing. Thus the main object to be achieved by the patent in suit is to provide a non-woven fabric having an improved heat deterioration resistance, a high elongation as well as a high heat shrinkability.

Document D1 discloses a method of producing a non-woven fabric which can be deep drawn. This requires that the polyethylene terephthalate filaments have the desired shrinkability.

Document D1 discloses in this respect filaments having an elongation at break of 100%, 200% or 300%. The skilled person knows the relationship between elongation and molecular orientation and he is aware that the desired molecular orientation can be accomplished by an appropriate adjustment

of the spinning speed. He would therefore realize that the filaments used in document D1 for producing non-woven fabrics have also the properties set out in Claim 1. It follows that the subject-matter of Claim 1 is implicitly disclosed in document D1 and is thus not novel having regard to this prior art document.

- (ii) Document D2 illustrates the knowledge of the skilled person having regard to polyethylene terephthalate fibres, which combine a high elongation of at least 100% with a high heat shrinkability of at least 15%. The skilled person is aware that such fibres are particularly desirable for producing deep drawn non-woven articles. The polyethylene terephthalate fibres disclosed therein have a higher degree of crystallisation in the outer layer portion as determined by measuring the refractive index and as a result an improved heat deterioration resistance. The central portion of these fibres has a lower degree of crystallisation so that this kind of fibres possesses a high elongation as well as an improved heat shrinkability. This two layer construction can be deduced from the statement in document D2, that the refractive index is "distributed symmetrically around the center of the cross-section of the fibres." The refractive index  $n_{\parallel}(0.8) - n_{\parallel}(0)$  is also mentioned in document D2.

Furthermore this citation gives some indications as to polyethylene terephthalate fibres having a two layer construction, an elongation of at least 100% as well as a heat shrinkability of at least 15%. Considering these indications the skilled person would realize that the polyethylene terephthalate filaments disclosed therein

correspond to that set out in Claim 1 and that such filaments can be used for producing the claimed non-woven sheet. It is also observed that document D2 discloses polyethylene terephthalate filaments with a refractive index of 1.583 and 1.611 (see Table 1). These values fall within the range of refractive indexes defined in Claim 1.

It follows that the subject-matter of Claim 1 is not inventive over the combination of documents D1 and D2.

VI. The Respondent (patent proprietor) requested that the appeal be dismissed and the patent be maintained as amended before the Opposition Division.

**Reasons for the Decision**

- 1. The appeal is admissible.
- 2. *Novelty*

Document D1 discloses non-woven fabrics made of partially stretched fibres. It is stated that these non-woven fabrics can be produced from Nylon-6 filaments having an elongation at break of 100%, 200% or 300% (column 1, lines 49 to 51).

This citation discloses neither polyethylene terephthalate filaments nor the claimed properties of said polyethylene terephthalate filaments, that is

(A)  $1.580 \leq n_{\parallel}(0) \leq 1.640$

(B)  $[n_{\parallel}(0.8) - n_{\parallel}(0)] \geq 6 \times 10^{-3}$

- (C) a shrinkage factor in boiling water, of at least 15% and
- (D) the symmetrical distribution of the partial average refractive index relative to the center of a filament section.

The Appellant contended that polyester fibres are specifically mentioned in document D1 and the skilled reader would understand that this term was being used to normally designate polyethylene terephthalate. If that is right, document D1 nevertheless does not disclose the features (A), (B), and (C) of the claimed polyethylene terephthalate filaments. It is also observed that the Appellant did not file evidence showing that the polyester fibres disclosed in document D1 have necessarily these features.

Accordingly the Board comes to the conclusion that the subject-matter of Claim 1 is novel over document D1.

Novelty over document D2 was not disputed by the Appellant and is acknowledged by the Board.

### 3. *Inventive step (Claim 1)*

- 3.1 The invention, subject-matter of the European patent, starts from a non-woven sheet produced from well-known undrawn polyethylene terephthalate filaments. As stated in the introductory part of the description, undrawn polyethylene terephthalate filaments have a high elongation at break point and an improved heat shrinkability and these filaments can be subjected to a post processing such as moulding in the form of non-woven sheets (see page 1 lines 18 to 20).

However, these undrawn polyethylene terephthalate filaments suffer from the problem that they are "subject to heat deterioration, in that their elongation at break point is reduced when they are heated" (page 1 lines 20 to 22 of the European specification).

Therefore the technical problem to be solved by the present invention is to provide a non-woven sheet having an improved heat deterioration resistance, while maintaining the advantages of the well-known undrawn polyethylene terephthalate filaments as to their high heat shrinkability and their high elongation.

3.2 This problem is in essence solved by the features stated in Claim 1, that is polyethylene terephthalate filaments having:

- an elongation at break of at least 100% and
- a shrinkage in boiling water of at least 15%,
- the filament section is a circular section having a radius R, and the average refractive index  $n_{||}(0)$  of the central portion of the filament section and the average refractive index  $n_{||}(0.8)$  of the portion apart by 0.8R from the centre satisfies the following requirements:
  - $1.580 \leq n_{||}(0) \leq 1.640$
  - $[n_{||}(0.8) - n_{||}(0)] \geq 6 \times 10^{-3}$
- the distribution of a partial average refractive index is symmetrical about the centre of filament section.

3.3 An essential feature of the filaments constituting the non-woven sheet according to Claim 1 is that they have a structure satisfying the following requirements in the filament section

$$(A) \quad 1.580 \leq n_{\parallel}(0) \leq 1.640$$

$$(B) \quad [n_{\parallel}(0.8) - n_{\parallel}(0)] \geq 6 \times 10^{-3}$$

As explained at page 6 lines 45 to 57 of the European patent the filament having the above structure is highly molecularly oriented and highly crystallised in the outer layer portion of the filament, and the centre portion, is lower molecularly oriented and lower crystallised compared with the outer layer portion of the filament. Therefore, this filament is an undrawn polyethylene terephthalate filament having a two ply construction. Further, the filament having the two ply construction according to the present invention has a substantially circular cross section and the orientation and the crystallinity thereof gradually increase from the centre portion to the outer layer portion.

The above requirement (B) must be satisfied to improve the heat deterioration resistance of the filament. However, if the requirement (B) is met but the requirement (A) is not met, i.e., the value of  $n_{\parallel}(0)$  is over 1.640, a filament having a high elongation cannot be obtained, and accordingly, a non-woven sheet made of such filaments has a low elongation. On the contrary, if the requirement A is satisfied but the requirement B is not met, the value  $n_{\parallel}(0.8) - n_{\parallel}(0)$  being less than  $6 \times 10^{-3}$ , the filaments are easily deteriorated.

As stated at page 7 lines 1, 2 of the European patent, to obtain filaments having an improved heat deterioration resistance and high elongation it is necessary that the filaments satisfy the requirements (A) and (B) and that they have a shrinkage factor in boiling water of at least 15% (requirement C).

3.4 Document D1 discloses a non-woven fabric made of polyester filaments having a high elongation and which can be deep drawn. This document, which corresponds in essence to the closest prior art stated on page 2 lines 18 to 22 of the patent in suit, is wholly silent as to the problem of improving heat deterioration resistance. There is thus no doubt that document D1 is of no utility to the skilled person trying to solve this problem. There is also no disclosure or suggestion of the claimed features (A), (B) and (C) so that his citation cannot lead the skilled person to the claimed solution.

3.5 The subject-matter of Claim 1 is a non-woven sheet. Document D2 does not relate to a non-woven sheet. It concerns polyester (polyethylene terephthalate) fibres which can be dyed under normal pressure. The polyester fibres disclosed therein can be used as knitted or woven fabrics. This citation does not contain any hint as to whether the fibres disclosed therein can be also used for producing non-woven fabrics.

As it is apparent from page 10, line 17, the polyethylene terephthalate fibres which are prepared in accordance with the teaching of document D2 have a low elongation of about 20% to about 60%. It is apparently not natural for a skilled person to combine the teaching of document D1 dealing with polyester fibres having a high elongation which can be used as non-woven

fabric with that of document D2 dealing with polyethylene terephthalate fibres having a low elongation and which can be used as knitted or woven fabrics, since these two techniques appear to be rather incompatible.

- 3.6 Furthermore, even if polyethylene terephthalate fibres according to the teaching of document D2 meet the requirement (B), the claimed requirement (A) is not satisfied: the refractive index  $n_{\parallel}(0)$  is said to be between 1.65 and 1.70 (see Claim 2 of document D2) as opposed to the claimed subject-matter where the refractive index  $n_{\parallel}(0)$  ranges from 1.58 to 1.64. As it is apparent from e.g. Table 1, Examples 1 to 3, the polyethylene terephthalate fibres prepared in accordance with the teaching of document D2 have a low elongation at break point combined with a low shrinkage factor in boiling water (2.9, 1.7 or 3.2%).

It is true that the requirement (A) in the claimed invention is met in comparative Examples 6 and 7 of document D2 but not the requirement (B). Furthermore it is clearly stated in this document that Examples 6 and 7 are comparative examples, which are not made according to the invention disclosed therein. It is also said that the filaments of these comparative examples "possess **inadequate** properties" (see page 25, Example 8).

The filaments which are prepared in accordance with the teaching of document D2 do not satisfy the requirement (A). The filaments which fall outside this teaching, that is the filaments of the comparative examples are said to be disadvantageous ("inadequate properties"). Thus the skilled person would only consider the teaching of document D2 and disregard the comparative examples.

Even if the skilled person had thought of combining the teaching of document D1 with that of comparative Examples 6 and 7 of document D2 he would not have achieved the object of the invention, that is a non-woven sheet having in particular an improved heat deterioration resistance: All but one of the claimed features (i.e. requirement (B)) are met by the comparative Examples 6 and 7. It results therefrom that a filament produced in accordance with these comparative examples cannot have a high heat deterioration resistance. This is evidenced by reference Example 6 of the patent in suit (see Table 1, page 13). In this example only the value of the requirement (B) ( $n_{11}(0.8) - n_{11}(0)$ ) falls outside the invention claimed with as a result a too low heat deterioration resistance. Example 6 shows also that the requirement (B) is an essential features of the invention.

In the Board's judgement, in view of the significant technical advantages of the solution claimed in Claim 1, that is an improved heat deterioration resistance combined with a high elongation at break point and a high heat shrinkability, this solution cannot be considered as self-evident or falling within the normal competence of the skilled person.

- 3.7 Therefore, in the Board's judgement, the subject-matter of Claim 1 involves an inventive step (Article 56 EPC).
4. As to the patentability of independent Claims 6 and 12 the following should be noted:

The non-woven sheet according to independent Claim 6 is formed by heat setting the non-woven sheet according to Claim 1 (see page 9, lines 33 to 35 of the patent in suit). The non-woven sheet according to independent Claim 12 is obtained by applying a needle punching

treatment and a heat shrinkage treatment to a non-woven sheet according to Claim 1 (see page 10 last paragraph of the patent in suit). The starting material which is required for preparing the non-woven sheets according to Claims 6 or 12 is the non-woven sheet according to Claim 1.

The Appellant contended that Claims 6 and 12 were in fact independent claims which were not subordinated to Claim 1. However, as at present drafted these claims cannot be made dependent to Claim 1, since they claim the final product after processing and not the starting material defined in Claim 1. Further, according to Article 69(1) EPC the description and drawings if any, shall be used to interpret the claims and there can be no doubt that according to the description of the patent in suit, the starting material for producing the non-woven sheets according to Claims 6 and 12 is that defined in Claim 1.

It follows that if the subject-matter of Claim 1 is patentable over the cited prior art documents, the subject-matter of Claim 6 or 12 is also patentable. Accordingly for the same reasons given herein above, the subject-matter of Claim 6 and that of Claim 12 are inventive over the opposed prior art.

5. Dependent Claims 2 to 5, 7 to 11 and 13 to 18 concern particular embodiments of the invention claimed in Claims 1, 6 and respectively 12 and are likewise allowable.

**Order**

**For these reasons it is decided that:**

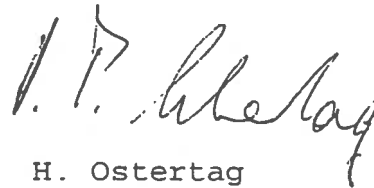
The appeal is dismissed.

The Registrar:



A. Townend

The Chairman:



H. Ostertag

