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D E C I S I O N
of 9 May 2000

Case Number: T 0164/96 - 3.3.6

Application Number: 90300483.6

Publication Number: 0386869

IPC: D01F 6/84

Language of the proceedings: EN

Title of invention:

Dual modulus oriented elastomeric filaments

Applicant:

GENERAL MOTORS CORPORATION

Opponent:

-

Headword:

Oriented filament/GENERAL MOTORS

Relevant legal provisions:

EPC Art. 56

Keyword:

"Inventive step (yes) - non-obvious combination of technical features"

Decisions cited:

-

Catchword:

-



Case Number: T 0164/96 - 3.3.6

D E C I S I O N
of the Technical Board of Appeal 3.3.6
of 9 May 2000

Appellant: GENERAL MOTORS CORPORATION
General Motors Building
3044 West Grand Boulevard
Detroit
Michigan 48202 (US)

Representative: Denton, Michael John
Delphi Automotive Systems
Centre Technique Paris
117 avenue des Nations
B.P. 60059
95972 Roissy Charles de Gaulle Cedex (FR)

Decision under appeal: Decision of the Examining Division of the
European Patent Office posted 6 November 1995
refusing European patent application
No. 90 300 483.6 pursuant to Article 97(1) EPC.

Composition of the Board:

Chairman: H. H. R. Fessel
Members: C. N. C. Raths
C. Rennie-Smith

Summary of Facts and Submissions

I. This appeal lies from the Examining Division's decision refusing the European patent application No. 90 300 483.6 (publication number 0 386 869), which related to dual modulus oriented elastomeric filaments.

The Examining Division held the subject-matter of process claim 1 and that of product claims 2 and 3 (Annex 1 of the decision under appeal) to be novel but not to involve an inventive step, in view of, inter alia, documents

(1) US-A-4 545 614

(2) *D.W.Van Krevelen & P.J. Hoftyzer*, "Properties of Polymers", Elsevier Scientific Publications Co., Amsterdam, 1976, 313;

In essence, the Examining Division based its arguments on the combination of documents (1) and (2).

II. After having been informed during oral proceedings, which were held on 9 May 2000, that the reasons given for the alleged violation of Article 113(1) EPC do not apply to product claims 2 and 3, the Appellant withdrew both that allegation and the related request for reimbursement of the appeal fee.

The Appellant requested that only Claim 1 as contained in the Annex 1 to the decision under appeal i.e. filed with the letter of 7 June 1995 should be considered. It requested that the decision under appeal be set aside and that a patent be granted on the basis of that Claim reading as follows:

"1. A method of making an oriented elastomeric filament spun from a thermoplastic elastomeric material which is a block copolymer consisting of a crystalline portion and an amorphous portion, in which the amorphous portion is not less than 0.5 mole fraction of the total copolymer, the block copolymer being either a block copolymer of polybutylene terephthalate and polytetramethylene glycol; a block copolymer of polybutylene terephthalate and polyethylene glycol/polypropylene glycol; a block copolymer of polybutylene terephthalate/polybutylene isophthalate and polyethylene glycol/polypropylene glycol; a block copolymer of polybutylene terephthalate/polyhexene terephthalate and polytetramethylene glycol; or a block copolymer of polyurethane and polytetramethylene glycol, the mole fraction of said polybutylene terephthalate, polybutylene terephthalate/polybutylene isophthalate and polybutylene terephthalate/polyhexene terephthalate in the respective block copolymer being less than 0.5, said elastomeric block copolymer being in the form of an as-spun, unoriented filament having a single stage stress-strain curve (C, Fig.2); said method comprises drawing and permanently deforming the as-spun elastomeric filament in at least one draw step at a temperature or temperatures in the range of 20°C to 120°C in a draw ratio greater than 5.0; and then annealing the drawn filament at a temperature in the range of 120°C to 140°C whilst allowing the drawn filament to shrink by a limited amount such that the net overall draw ratio of the filament is in the range of 5.0 to 7.0, said oriented elastomeric filament exhibiting a two-stage low tensile modulus and high

tensile modulus behaviour and an ultimate strain no larger than 140% when tested in accordance with ASTM D-638 tensile test procedures."

III. At the end of the oral proceedings the Board's decision was announced.

Reasons for the Decision

1. *Articles 84 and 123 EPC*

The Examining Division concluded that the requirements of Article 84 EPC are met and that the subject-matter of Claim 1 does not extend beyond the content of the application as filed (Article 123(2) EPC). The Board came to the same conclusion.

2. *Novelty*

The Board is also satisfied that the subject-matter of Claim 1 meets the requirements of Article 54 EPC as already acknowledged by the Examining Division.

3. *Inventive step*

3.1 The application in suit relates to a process for making oriented elastomeric filaments which exhibit a dual modulus or a two-stage low tensile modulus and high tensile modulus type of mechanical behaviour; said filaments should be used in a seat suspension element in a vehicle seat assembly (patent application in suit, page 2, lines 3 to 12).

A vehicle seat having a multiplicity of side by side

elastomeric filaments prestretched across spaced side frames (column 1, lines 4 to 6) is disclosed in document (1).

The object of document (1) was to remove the disadvantage of conventional elastomers which have a too low modulus of elasticity; under static conditions, these elastomers support a person comfortably but, when a vehicle hits a bump or pothole, they stretch causing the seat to deflect and bottom out and then rebound (column 1, lines 20 to 25). This was also an objective of the Appellant: "When the automobile experiences vertical displacements (bumps) and the passenger is jostled, the impact of the passenger's weight on the seat does not cause the filaments to elongate excessively, and the seat does not bottom out" (see letter dated 2 February 1996, page 2, paragraph 3). The oriented elastomeric filament should absorb vehicular vibrations and provide increased support in response to increased load (application in suit, page 3, lines 4 and 5).

3.2 Thus, with respect to document (1), which the Board takes as the starting point for evaluating inventive step, the technical problem to be solved can be seen in the provision of a process for making improved elastomeric filaments for use in vehicle seats.

3.3 The passage on page 4, lines 29 to 57 of the application in suit explains the stress/strain curves of oriented and unoriented filaments in the Figures 2, 3 and 4. According to the method of Claim 1, the filament exemplified by Hytrel 4056 was drawn at a temperature of 20°C to 120°C in a draw ratio greater than 5.0, then annealed at 120°C to 140°C, so that the

net overall draw ratio was between 5.0 and 7.0; the oriented elastomeric filament exhibited an ultimate strain no larger than 140% (ASTM D-368, tensile test procedures) (page 4, lines 4 to 13; page 5, line 19, Table II). Having regard to Figure 4 of the application in suit, for a given strain value, the stress values of the filaments are higher for a draw ratio of 5 than for a draw ratio of 3.5. Having regard to Figure 6 of document (1), for a given strain value, the stress values of the filaments are lower than those of the filaments of the application in suit. In view of these data, the Board is satisfied that the problem underlying the application in suit is indeed solved by the process according to Claim 1.

- 3.4 It remains to be decided whether the process according to Claim 1 of the application in suit involves an inventive step.
- 3.4.1 According to document (1) the process step of annealing filaments, made of a block copolymer comprising a crystalline segment and an amorphous segment, at a specific temperature while they were stretched oriented the molecules of the crystalline segment in one direction while leaving the molecules of the amorphous segment unaffected. This procedure increased the material stiffness and more than tripled its strength. An example of such a material is Hytrel, a registered trademark of Du Pont De Nemours Company (column 3, lines 18 to 25). The Hytrel filaments were prestretched between 50 and 75% strain. The oriented Hytrel filament had an ultimate tensile strength of 170 mPa and a modulus elasticity of 20 mPa at 100% elongation. The Hytrel stress strain curve tended to plateau in the range of strain between 20 and 100% elongation;

filaments prestretched at this range provided good comfort and they easily deflected to adjust to the shape of the occupant. With a sudden change of stress they reacted by stiffening at strains above 100% to support the additional load. The stress-strain measurements showed that Hytrel filaments had good hysteresis, i.e. the stress at a given strain during stretching was much higher than during release of stress. Much of the energy absorbed during stretching was dissipated and not regained when the filament was relaxed. The result was better dampening of impacts (column 3, line 33 to column 4, line 8).

3.4.2 The difference between the process of the patent application in suit and that of document (1) lay in the net overall draw ratio of 5.0 to 7.0 in combination with two preceding steps, namely one drawing step at 20°C to 120°C in a draw ratio greater than 5.0 and an annealing step at 120°C to 140°C whilst allowing the filament to shrink.

The draw ratio of greater than 5 and the temperatures of the drawing step and of the annealing step were not present in document (1).

The draw ratio of 5 to 7 in combination with the specific drawing and annealing temperatures resulted in an ultimate strain no larger than 140% when tested in accordance with ASTM-D-638 tensile test procedures (see page 5 of the application in suit, Table II, filament annealed at 120°C).

Thus a draw ratio higher than 5 is considered to be crucial in that combination since a draw ratio of 3.5 gives a lower strength filament which does not have the

desired stress/strain curve (page 4, lines 53 to 58).

Thus, for the reasons given above, document (1) alone gives no hint of the claimed solution.

- 3.4.3 Document (2) relates to properties of polymers, their estimation and correlation with chemical structure; in the second full paragraph on page 313, the effects of orientation are described: "If the orientation process in semi-crystalline fibres is carried out well below the melting point (T_m), the thread does not become thinner gradually, but rather suddenly, over a short distance: the neck. The so-called draw ratio ($\bar{\epsilon}$) is the ratio of the length of the drawn to that of the undrawn filament: it is about 4 to 5 for many polymers, but may be as high as 10 for linear polyolefins and as low as 2 in the case of regenerated cellulose."

The Board does not consider document (2) to be of immediate relevance since it refers to a draw ratio regarding the definition of the neck; the fact that the thread becomes suddenly thinner would not be helpful for finding a solution to the problem underlying the application in suit since the filament of the invention has to absorb vehicular vibrations and provide increased support in response to increased load.

- 3.4.4 The influence of the draw ratio on the stress/strain curve in combination with the specific drawing and annealing temperatures was not taught by document (1); it is this combination which made the stress of the oriented fiber climb faster than that of the oriented fiber of document (1). In the event of an increase of load, the oriented fiber of the application in suit provides more support than the oriented filament of

document (1). This improvement in support is quantifiable: at the same elongation, the modulus of the oriented fiber of the application in suit is higher than the modulus of the oriented fiber of document (1). Thus the method of Claim 1 yields an oriented filament that provides the support needed to prevent the passenger from making contact with the seat frame.

Since there is no pointer in document (1) to the criticality of the draw ratio, the process of Claim 1 of the application in suit involves an inventive step.

Order

For these reasons it is decided that:

1. The decision under appeal is set aside.
2. The case is remitted to the Examining Division with an order to grant a patent on the following basis:

Claims: Claim 1 as contained in Annex 1 to the decision under appeal

Description: to be adapted thereto

Figures: as in the application.

The Registrar:

The Chairman:

G. Rauh

H. Fessel