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File Number: T 487/89 - 3.3.3

Application No.: 83 106 725.1

Publication No.: 0 098 616

Title of invention: High tenacity polyhexamethylene adipamide fiber

Classification: D01F 6/60

DECISION
of 17 July 1991

Proprietor of the patent: Asahi Kasei Kogyo Kabushiki Kaisha

Opponent: 01 Viscosuisse SA
02 Akzo N.V.
03 E.I. Du Pont de Nemours and Company

Headword:

EPC Articles 56, 83, 84

Keyword: "Inventive step - denied" - "Sufficiency of disclosure despite serious numerical error" - "Clarity of claims when lacking limit to range"

Headnote



Case Number : T 487/89 - 3.3.3

D E C I S I O N
of the Technical Board of Appeal 3.3.3
of 17 July 1991

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(Proprietor of the patent)

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Decision under appeal : Decision of Opposition Division of the European
Patent Office of 26 April 1989, issued on
15 June 1989, revoking European patent
No. 0 098 616 pursuant to Article 102(1) EPC.

Composition of the Board :

Chairman : F. Antony
Members : R.A. Lunzer
M.K.S. Aúz Castro

Summary of Facts and Submissions

I. European patent No. 98 616 was granted on 20 August 1986 on the basis of application No. 83 106 725.1 filed on 8 July 1983, claiming priority derived from Japanese applications Nos. 117786/82 and 73736/83 dated respectively 8 July 1982 and 28 April 1983. Claim 1 read as follows:

"1. Polyhexamethylene adipamide fiber having a tenacity of at least 883 mN/tex (10 g/d) and a formic acid relative viscosity of at least 50, characterized by
(a) a formic acid relative viscosity of 70 to 150,
(b) a coefficient of stability of tie molecule of at most 0.20,
(c) a shrinkage percentage of at most 4% with no load at 160°C in dry heat for 30 minutes; and
(d) a toughness of at least 17.66 N/tex (200 g/d)%."

Claim 5 was a process claim which specified four process steps substantially corresponding to (i) to (iv) set out in VI. below.

II. Oppositions were filed on 13, 12, and 20 May 1987 respectively on the part of the first, second, and third Respondents on the grounds of Article 100(a) and 100(b) EPC, alleging lack of novelty (Article 54 EPC), lack of inventive step (Article 56 EPC), and insufficient disclosure of the invention (Article 83 EPC). The Opponents relied in particular on the following documents:

- (1) US-A-3 311 691
- (2) DE-A-1 808 432
- (3) JP-A-73/32 616, with an English translation filed on 8 March 1989.

III. By its decision given orally on 26 April 1989, and issued in writing on 15 June 1989, the Opposition Division revoked the patent, holding that the alleged invention was novel, but lacking in any inventive step. It regarded document (1) as being the closest prior art. This disclosed the production of polyamide yarn having very similar properties to those of the alleged invention, the only substantial difference between the alleged invention and this prior art being that the alleged invention in its process of manufacture involved the step of solid-phase polymerization before spinning, which was not disclosed in document (1). However, the advantage of using a solid-phase polymerization step when wishing to achieve greater tenacity was disclosed in document (2). It was thus obvious to combine the teachings of both said documents.

IV. Regarding the sufficiency of the disclosure under Article 83 EPC, it was accepted by the Appellant in the course of the opposition that, in the description at column 6 line 49, the factor of 62.5 had erroneously been left out of the definition of the coefficient of stability of the tie molecules. This coefficient had an upper limit of 0.20 in feature (b) of Claim 1 as granted. The Opposition Division did not allow an amendment by way of correction to insert the missing factor into the description, nor did it permit a proposed amendment deleting the wrongly defined coefficient from the claim, on the ground that such deletion would offend against Article 123(2) EPC. Further, it held that there were open ended ranges for both the tenacity of the fibre and its toughness (defined as meaning tenacity x elongation

(col. 5 line 59)). It was observed that wherever a claim contains parameters regarding the goal of the invention and which are "obvious desiderata", the range covered by these parameters should be restricted to that effectively obtainable in the light of the disclosed process features. On both these grounds it held that the claim was not supported by the description, and the disclosure was therefore insufficient, offending against the provisions of Article 83 EPC.

V. An appeal against that decision was lodged on 27 July 1989, the appeal fee was paid on the same day, and the Grounds of Appeal were filed on 23 October 1989. In the Statement of Grounds of Appeal, and during oral proceedings held on 17 July 1991, the Appellant argued that document (3), rather than document (1), was the closest prior art, and that it would not have been obvious to combine its teaching with that of document (2), to arrive at the alleged invention. The Appellant also relied on the fact that improved tenacity was highly desirable in polyamide fibres used for tyre reinforcement, and especially so was the property of retaining tensile strength after the tyre had been vulcanized. The age of the cited documents confirmed that it could not have been obvious to have used the claimed expedient. The objections of insufficiency of disclosure were also contested.

VI. Together with its Statement of Grounds of Appeal, the Appellant filed a Main Request, and four Auxiliary Requests. In response to an indication from the Board at the oral proceedings that it would not be willing to permit the deletion of the essential feature (b) from any product claim, the Appellant submitted a Main Request and a single Auxiliary Request, Claim 1 of each of the two Requests being in the form set out below:

Main Request

"Polyhexamethylene adipamide fiber having a tenacity of at least 883 mN/tex (10 g/d) and a formic acid relative viscosity of at least 50, characterized by

- (a) a formic acid relative viscosity of 70 to 150,
- (b) a coefficient of stability of tie molecule of at most 0.20,
- (c) a shrinkage percentage of at most 4% with no load at 160°C in dry heat for 30 minutes; and
- (d) a toughness of at least 17.66 N/tex (200 g/d)%, and produced by a direct spinning, drawing and heatsetting process, characterized in that:
 - (i) polyhexamethylene adipamide obtained by melt polymerization and having a formic acid relative viscosity of at most 70 is used as starting material;
 - (ii) the starting material according to (i) is subjected to a solid-phase polymerization at a temperature of 180 to 240°C up to a formic acid relative viscosity of 75 to 150;
 - (iii) the polymer obtained according to (ii) is subjected to melt spinning to form spun fibers, cooling the spun fibers, adding an oiling agent to the cooled filaments, immediately taking up the oiled filaments with rollers in multi-steps which are rotating at successively increased circumferential velocities to conduct multi-step drawing and heat-setting, where the drawing is conducted in at least two steps among rollers and where the ratio (DR) of the speed of said fiber leaving the drawing step having the highest circumferential velocity to the speed of said fiber entering to the first

drawing step satisfies the following condition:

$$5.2 \leq DR \leq 6.5,$$

and where the surface temperature of the rollers which rotates at the highest circumferential velocity or of at least one among those in a subsequent position is of 220 to 250°C (except the first one of said rollers); and

- (iv) the fiber stretched according to (iii) is wound in such a manner as to satisfy the following condition:

$$0.92 \geq TS/GS \geq 0.86$$

where TS = winding speed and GS = circumferential velocity of rollers having the highest circumferential velocity."

Auxiliary Request

"Process for the production of polyhexamethylene adipamide fibers, where said process is a direct spinning, drawing and heatsetting process, characterized in that:

- (i) polyhexamethylene adipamide obtained by melt polymerization and having a formic acid relative viscosity of at most 70 is used as starting material;
- (ii) the starting material according to (i) is subjected to a solid-phase polymerization at a temperature of 180 to 240°C up to a formic acid relative viscosity of 75 to 150;

(iii) the polymer obtained according to (ii) is subjected to melt spinning to form spun fibers, cooling the spun fibers, adding an oiling agent to the cooled filaments, immediately taking up the oiled filaments with rollers in multi-steps which are rotating at successively increased circumferential velocities to conduct multi-step drawing and heat-setting, where the drawing is conducted in at least two steps among rollers and where the ratio (DR) of the speed of said fiber leaving the drawing step having the highest circumferential velocity to the speed of said fiber entering to the first drawing step satisfies the following condition:

$$5.2 \leq DR \leq 6.5,$$

and where the surface temperature of the rollers which rotates at the highest circumferential velocity or of at least one among those in a subsequent position is of 220 to 250°C (except the first one of said rollers); and

(iv) the fiber stretched according to (iii) is wound in such a manner as to satisfy the following condition:

$$0.92 \geq TS/GS \geq 0.86$$

where TS = winding speed and GS = circumferential velocity of rollers having the highest circumferential velocity."

VII. The Respondents argued in their written statements, supplemented by their arguments at the oral proceedings,

that there was a serious insufficiency of disclosure, because the accidental omission of the factor of 62.5 would have a profound impact on the skilled worker attempting to repeat the teaching of the alleged invention. Further they argued that whether one were to start from the teaching of document (1) or document (3), there was no inventive step in appreciating that the use of solid-phase polymerization would improve the retention of tenacity. This step was taught in document (2) as being particularly useful in polyamide fibre for use in tyre reinforcement.

- VIII. The Appellant requested that the decision under appeal be set aside, and that the patent be maintained on the basis of Claims 1 to 8 filed during the oral proceedings; alternatively, on the basis of Claims 1 to 4 filed as Auxiliary Request II (now the only Auxiliary Request) filed on 23 November 1990.

Reasons for the Decision

1. The appeal complies with Articles 106 to 108 and Rule 64 EPC, and is admissible.
2. Admissibility of amendments

Claim 1 of the Main Request as set out above combines all the product features of Claim 1 as granted, with all the process steps which were present in Claim 5 in the patent as granted. Such mere combination cannot possibly offend against the provisions of Article 123(2) or 123(3) EPC. Furthermore, the limitation of the "stretching means" to "rollers" is admissible since rollers were disclosed as the preferred stretching means at page 4 line 29 of the application as originally filed.

In accordance with the Auxiliary Request, the reference to Claims 1 to 4 which appeared in Claim 5 as granted has been deleted. This deletion is permissible because the Board treats such a claim to a method for the production of a given product as meaning a method suitable for, but not necessarily limited to, the production of the product in accordance with Claims 1 to 4. Hence, the deletion of such a limitation does not materially affect its scope.

The proposed amended Claim 1, whether in accordance with the Main Request, or in accordance with the Auxiliary Request, are both free from any valid objection under Article 123 EPC.

3. Sufficiency

3.1 The first of two objections of insufficiency arises from the erroneous omission of the factor of 62.5 from the definition of the coefficient of stability of the molecule at column 6 line 49 of the patent as granted. There is no dispute as to the facts relating to this issue. Because the factor of 62.5 was omitted, the intended upper limit of integer (b) of Claim 1 was $0.20/62.5$; i.e. 0.0032. As the upper limit expressed in the claim is more than fifty times larger than intended, almost any polyamide polymer, whether made in accordance with the prior art or in accordance with the alleged invention, would be likely to fall well inside this unduly high upper limit.

3.2 This state of affairs gives rise to the issues of whether an error of this nature is curable at all, and, secondly, if incurable, whether it is fatal to the validity of the patent. In the view of the Board, as there was no suggestion in the application as originally filed of the need for the factor of 62.5, it can not be added as a

later amendment without clearly offending against the provisions of Article 123(2) EPC. Correction under Rule 88 EPC is not permissible either, because the condition of the second sentence of the said Rule, i.e. that it must be "immediately evident that nothing else would have been intended than what is offered as the correction" is clearly not satisfied. No more detailed consideration of that possibility is called for here because correction was not requested at the appeal stage. In summary, in the present case this error can not be corrected.

3.3 Given that the error is incurable, the remaining issue is the impact, if any, of the error on the sufficiency of the disclosure, and hence on the validity of the patent. On the present undisputed facts, a person attempting to put the invention into effect would in all probability find that the coefficient was very much smaller than the description had led him to expect. Indeed, it would be so much smaller, that he might well suspect that there was an error in its definition. But the existence of this error would not impede him from repeating the Examples in the present patent, nor would it stop him from producing a useful end product. Accordingly, the Board finds that the disclosure is sufficient from the point of view of the skilled worker, and therefore that the objection of insufficiency of disclosure contrary to Article 83 EPC on the ground of the omission of the factor of 62.5 is not established.

3.4 Before leaving this topic, the Board observes, obiter, that had the error in the patent in suit been in the opposite direction, in the sense that as a result of an arithmetical error nothing could be made which fell within a given integer expressed in the claim, then unless the conditions for permitting a correction in accordance with

Rule 88 EPC were satisfied (see 3.2 above), it is likely that the disclosure would be irremediably insufficient.

3.5 The second objection of insufficiency was based on the fact that both the tenacity, and the toughness (here defined as meaning tenacity x elongation (col. 5 line 59)) had been indicated with a lower, but without any upper limit. The Opposition Division took the view that such "open-ended" parameters are always objectionable if they relate to an inherently desirable characteristic. The Board does not accept that view in its generality. Whether the absence of an upper or lower limit is acceptable in a claim in any individual case depends on all the surrounding circumstances. Where, as in the present case, the claim seeks to embrace values which should be as high as can be attained above a specified minimum level, given the other parameters of the claim, then such open-ended parameters are normally unobjectionable. The Board is therefore satisfied that the disclosure of the patent in suit meets the requirements of Article 83 EPC.

4. Clarity

4.1 It is established law that where an Opposition Division or Board of Appeal is considering the allowability of an amendment, then, although Article 84 EPC is not itself a ground of opposition, nonetheless the issue of whether the claim, when amended, is sufficiently clear to meet the requirements of Article 84 EPC may have to be taken into account (T 23/86, OJ EPO 1987, 316; T 301/87, OJ EPO 1990, 335; T 472/88 of 10 October 1990 (unpublished)).

4.2 At page 9 of its decision, the Opposition Division refused to allow an amendment of Claim 1 to a product by process claim on the ground that such claims are admissible only if there is no other means of characterizing a product. In

the view of the Board, that objection was too broadly stated. Although in general product by process claims are to be avoided, there may be circumstances, such as in the present case, where although the product might be capable of being defined in terms of specific parameters, there are no such parameters available to the patentee for introduction into the claim, whereas process features taken from a sub-claim may overcome an objection of lack of novelty, or lack of inventiveness.

4.3 In the present case the Board does not consider that there is any valid objection to the clarity of Claim 1 as proposed to be amended, and there is therefore no sustainable objection under Article 84 EPC.

5. Novelty

Novelty of the subject matter of the Main or the Auxiliary Request was not in issue on appeal. Having reviewed the cited documents, the Board is satisfied that none of them discloses a nylon 6.6 fibre having all the features defined in Claim 1. Therefore the subject matter of Claim 1 is novel within the meaning of Article 54 EPC.

6. Considerations re Article 56

The issue of whether there is any inventive step covered by the claims in accordance with the Main and the Auxiliary Requests may be dealt with at the same time, because their respective subject matters are based on the same allegedly inventive idea.

6.1 Closest prior art

In the Board's view, document (3) is the closest prior art. As illustrated in the Table presented by the

Appellant at page 10 of the Grounds of Appeal, this prior document discloses the production of nylon 6.6 filaments, by direct spinning, with multi-step drawing using rotating stretching means, employing a draw ratio of 4.7 to 6.2. Although the relationship TS/GS, i.e. the relative speed of the winding roll to the speed of the last stretching roll, is not specified in (3), it was not disputed that it is common practice to permit relaxation following drawing and before winding, as is indicated in document (1), where the ratio TS/TG is 0.985 - 0.895. Thus the disclosure of document (3), expressly, or by implication from what is established as being commonplace in the industry, covers all the features of the alleged invention, with the sole exception of the solid-phase polymerization step. The lower temperature range (145 - 220°C) disclosed in (3), as contrasted with the range in the alleged invention of 220 - 250°C is - without dispute - a consequence of the higher molecular weight resulting from solid phase polymerization, and it is thus not an independent feature. On the other hand, document (1) differs in the nature of the stretching means, and is the prior art which (3) uses as its starting point. This is why the Board considers it more appropriate to choose (3) as the closest prior art with regard to the claimed subject matter of the patent in suit.

6.2 Problem

Given document (3) as a starting point, the objective problem, (as also the problem alluded to in the patent in suit col. 1 lines 7 to 10) was to find a way of improving nylon 6.6 fibres of the kind used in tyre making so that their tenacity after vulcanization of the tyre would be less reduced.

6.3 Solution

The solution proposed by Claim 1 (both requests) of the patent in suit involves the use of a solid-phase polymerization step prior to the extrusion of the polymer. The numerous Examples and comparative Examples given in the patent, and especially the unchallenged values given at the end of the Appellant's written submission dated 22 November 1990, demonstrate to the Board's satisfaction that the alleged invention credibly solves the problem, and that the fibres when so made have better retention of tenacity after vulcanisation than was attainable in the past.

6.4 Inventive step

6.4.1 The issue of inventive step turns on whether a skilled person, having as his starting point the disclosure of document (3), and confronted with the problem of improving the retention of tenacity after vulcanization, would have appreciated that a solid-phase polymerization step before spinning could afford a solution to that problem. In this connection, document (2) teaches at page 3 lines 4 to 19 that where high tenacity nylon 6.6 fibres are required, such as in tyre manufacture, it is recommended to subject the polymer to solid-phase polymerization immediately prior to extrusion. The proposed temperatures of polymerisation in document (2) are indicated as being in the range of 180 -240°C at page 5 lines 11 and 12, while in its Examples 1, 2, 4, 5, and 6 the temperature used is 220°C, in Example 3 it is 210°C, and in Example 7 it is 200°C. Also, the duration of the polymerization (2.25 to 10 hours) is similar to the range of 3.5 to 7.2 hours (disregarding test "A" which lies outside the claimed invention because of the temperature of only 170°C) given in Table 1 page 10 of the patent in suit. Thus it is clear

that the times and temperatures given in document (2) are comparable to the times and temperatures disclosed in the patent in suit.

- 6.4.2 It is true that the range of temperatures proposed for use in the hottest drawing step in document (3) (145 to 220°C, see Claim 1) meet, but do not overlap, with the range of 220 to 250°C proposed in the patent in suit (cf. granted Claim 5). However, it was undisputed that a higher drawing temperature would normally be used with a polymer of higher molecular weight, and consequently higher melting point, so that this is no more than an effect of the step of solid-phase polymerization.
- 6.4.3 It is the established jurisprudence of the Boards of Appeal (see e.g. T 21/81, OJ EPO 1983, 15) that a beneficial effect (which is accepted as existing in the present case; see 6.3 above) does not render a claimed proposal inventive if it is the result of having done the obvious. Taking into account what has been set out in the two preceding paragraphs, the Board has reached the conclusion that it would have been obvious to the skilled worker confronted with the above identified problem to have sought a solution to it in the combined teachings of documents (3) and (2), and thus he would have arrived at the alleged invention.
- 6.4.4 In the circumstances of the present case the Board is unable to attach any significant weight to the Appellant's argument to the effect that the non-obviousness of the alleged invention was suggested by the considerable age of all the cited prior art, and that the improvement brought about by the alleged invention was significant from the point of view of the tyre making industry. As the Respondents contended, the failure of the industry hitherto to adopt the use of solid-phase polymerization

can be explained by Table 1 at page 10 of the specification in suit, which shows that the time taken for solid-phase polymerization could range from 3.5 to 7.2 hours; there were thus good economic reasons explaining why the alleged invention had not previously been suggested.

7. Conclusion

The subject matter of Claim 1 of the patent in issue thus is lacking in any inventive step, and therefore fails to satisfy the essential requirement of Article 56 EPC. As there is no Auxiliary Request directed to any combination of sub-claims, the Board does not need to consider whether there could be any independent inventive merit in the sub-claims. Accordingly, the appeal against the revocation of the patent in suit must be dismissed.

Order

For these reasons, it is decided that:

The appeal is dismissed.

The Registrar:


E. Gorgmaier

The Chairman:


F. Antony