BESCHWERDEKAMMERN DES EUROPÄISCHEN PATENTAMTS

BOARDS OF APPEAL OF THE EUROPEAN PATENT OFFICE

CHAMBRES DE RECOURS DE L'OFFICE EUROPEEN DES BREVETS

Publication in the Official Journal ~~Yes~~ / No

File Number: T 651/90 - 3.2.2

Application No.: 85 304 037.6

Publication No.: 0 167 303

Title of invention: Fiber reinforced thermoplastic material and method of making it

Classification: B29C 47/02, B29C 67/14

D E C I S I O N
of 18 February 1992

Proprietor of the patent: E.I. DU PONT DE NEMOURS AND COMPANY

Opponent: BASF Aktiengesellschaft, Ludwigshafen (D)
AKZO N.V., Arnhem (NL)

Headword:

EPC Articles 54, 56, 83 and 114(2)

Keyword: "Claims infected by unclear parameters - (no)"
"Inventive step - (yes)"

Headnote

Europäisches Patentamt | European Patent Office | Office européen des brevets

Beschwerdekammern | Boards of Appeal | Chambres de recours

Case Number : T 651/90 - 3.2.2

D E C I S I O N
of the Technical Board of Appeal 3.2.2
of 18 February 1992

Appellant : (Opponent)
Akzo N.V.
Velperweg 76
NL-6824 BM Arnhem (NL)

Representative :
Sieders, René
AKZO N.V.
Patent Department (Dept. CO)
P.O. Box 9300
NL-6800 SB Arnhem (NL)

Other party : (Opponent)
BASF Aktiengesellschaft, Ludwigshafen
-Patentabteilung - C6-
Carl-Bosch-Strasse 38
W-6700 Ludwigshafen (DE)

Respondent : (Proprietor of the patent)
E.I. DU PONT DE NEMOURS AND COMPANY
1007 Market Street
Wilmington
Delaware 19898 (US)

Representative :
Jones, Alan John
CARPMAELS & RANSFORD
43 Bloomsbury Square
London, WC1A 2RA (GB)

Decision under appeal :
Decision of Opposition Division of the European Patent Office of 26 April 1990, posted on 19 June 1990, rejecting the oppositions filed against European patent No. 0 167 303 pursuant to Article 102(2) EPC.

Composition of the Board :

Chairman : G.S.A. Szabo
Members : J. Du Pouget De Nadaillac
F. Benussi

Summary of Facts and Submissions

I. The Appeal is directed against the decision of the Opposition Division of 26 April 1990 and posted on 19 June 1990. This decision rejects the oppositions and maintains the patent in suit as granted.

II. The patent was opposed by the Opponents on the grounds that it did not satisfy Articles 83, 54 and 56 EPC (Articles 100(a) and (b) EPC). During the opposition proceedings, the following prior art documents, among others, were, inter alia, cited:

(1) US-A-3 993 726
(3) CA-A-743 498
(4) US-A-3 243 949
(8) DE-A-2 312 816
(9) US-A-4 414 266

III. The Opponent 02 (Appellant) filed the appeal on 7 August 1990, the appeal fee being paid on the same day. The Statement of Grounds of Appeal was filed on 18 October 1990. The Appellant stated that the process claims were not patentable under Articles 83, 52 and 56 EPC, since the relative viscosity parameter mentioned in these claims was meaningless and since the method according to Claim 1 should be obvious in view of documents (3) and (4). He further stated that the product claims were also obvious and not patentable, because the unusual parameter given in these claims was so inaccurate, that the subject-matter of these claims was nothing more than an obvious desideratum.

IV. Oral proceedings were held on 18 February 1992. Opponent O1, duly summoned to these proceedings, had informed the EPO on 29 January 1992 that he would not attend them. During these proceedings, the Respondent (Patentee) submitted new independent product Claims 5 and 6, the other claims remaining as granted.

V. The granted process claim, namely Claim 1, reads as follows:

"A method of making a fiber reinforced thermoplastic material comprising: advancing a tensioned array of fiber bundles (10) in sliding contact with an arcuate surface (21) of a heated extruder head (20); moving a molten thermoplastic polymer (23) having a relative viscosity of at least 50 in a flow under pressure from one side to the other through the tensioned array of filaments (10) from a slot (25) in the arcuate surface (21) of the extruder head (20), said slot (25) being transverse to said one side of the filament array; expelling air from the other side of said filament array (10) by means of said flow, and forming polymeric protrusions (31) on said other side of said filament array."

Independent product Claim 5, now under consideration, reads as follows, the amendment brought during the oral proceedings being presented with emphasis:

"A fiber reinforced thermoplastic material, **obtainable by the method of any one of Claims 1 to 3**, comprising: an array of synthetic fiber bundles comprised of continuous filaments and a thermoplastic polymer coating substantially all sides of the filaments in the array to form a composite, said fiber bundles comprising from 50 to 60 percent by volume of said composite, the uniformity of distribution of said filaments in said composite as

measured by the ratio of the mass mean length (L) ("mass mean length" means the sum of the linear distances between fiber bundles each of which is raised to the power of four divided by the sum of the same linear distances each of which is raised to the power of three) between fiber bundles in the composite consolidation direction to the mass mean length between fiber bundles in the direction perpendicular thereto being from about 0,5 to about 1.0."

Independent Claim 6 contains all the features of Claim 5, however with the two following differences:

(a) The fiber bundles comprise 50 to 75 percent by volume of said composite, and
(b) The values of (L) in either direction are not greater than the following:

% Fiber	L
50	25
55	20
60	15
65	10
70	6
75	3

VI. The arguments of the Appellant are in substance as follows:

(a) Process claims

The relative viscosity mentioned in Claim 1 is a parameter which cannot be used to characterize a polymer as long as other parameters are not given, for example the polymer itself, the solvent, the test temperature and the polymer concentration. This claimed parameter, although being the

essence of the invention, is therefore meaningless. The two US documents mentioned in the description, page 5, do not show in fact how to measure this relative viscosity and moreover, one of them, the Speck US patent (US-A-3 393 210), shows not only a great variety of polymers, but also great varieties of forms for each polymer, depending on their configuration and molecular weight, so that even the mention of a particular polymer is insufficient.

An essential feature, namely the pre-heating step of the filaments, is missing in Claim 1. Without this step, the polymer stream, being at 400°C, will solidified as soon as it touches the cooled filaments, and thus the claimed method would not work.

Document (3) is concerned by the same main problem, namely to obtain, prior to its moulding, a good fiber reinforced intermediate product. Although the glass filaments described therein are impregnated with a thermo-hardening material, the general teaching of this prior art is directed to quick hardening substances, which includes inter alia thermoplastics. Many documents show that thermoplastics and rapid hardening materials are equivalent and, since thermoplastics are cheaper, they are always preferably used. Further, the relative viscosity wanted for this material in the contested Claim 1 is in itself an obvious requirement, since, when high tenacity is wished, high viscosity is necessary; in others words, it is quite usual to take a high molecular height product in order to make a product having a high strength. Regarding the other features of the contested Claim 1, no technical difference can be seen between the slot of the extruder head claimed in the present invention and the ray of holes sealed by the strands of filaments, which are disclosed in the above mentioned document as providing a

good impregnation. Thus, the process of Claim 1 is obvious.

b) Product claims

The parameter mentioned in both independent product Claims 5 and 6, namely a ratio of mass mean lengths L between fiber bundles, is so unusual and inaccurate that it is unsuitable to define a product. It is unclear whether the distance x, used to define L, should be measured between the filaments or between the fiber bundles, particularly when a particular configuration of fiber bundles, like the one shown in the left part of Figure 6, is concerned. A ratio of 1.0, which according to the description should show the best homogeneity, is also obtained when a symmetrical distribution in both directions is realized, although there is in this case no homogeneity. Table II in the description gives margins for the values, which are of the same amplitude as the values, so that the values themselves are indefinite and can be within or outside the claimed range. Moreover, the best example given, namely Example 3 of this table II, shows a ratio value of 0,84, far from the maximum theoritically obtainable homogeneity (ratio of 1.0), demonstrating that the patentee cannot make a product having a value higher than 0,84. Claims 5 and 6 are therefore open-ended claims, violating Article 83 EPC. They are typical examples of claims infected by "parametritis", i.e. a meaningless manipulation of parameters.

For the product claims, document (8) is the closest prior art. It deals already with the same problem of avoiding voids in a fiber reinforced product, teaches to preheat the filaments and to coat all sides of these filaments with a thermoplastic material. The fiber bundles comprise from 10 to 70 percent by weight of the obtained composite.

The idea of moving the molten thermoplastic polymer in a flow under pressure trough the array of filaments to push away the air is given in this prior art. Thus, the only difference remaining betwen this prior art and the subject-matter of Claims 5 and 6 is the unsuitable parameter L, which can only be considerated as an obvious desideratum.

VII. The Respondent contested these arguments. Concerning the parameters in the method and product claims, he drew the attention on the patent description, which gives all the necessary information. He, moreover, also protested against the introduction during the oral proceedings of the new arguments relative to the obviousness of the product claims.

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

The Respondent requested that the appeal be dismissed and that the patent be maintained on the basis of Claims 1 to 4 as granted, Claims 5 and 6 as amended during the oral proceedings, Claims 7 to 11 as granted, and description and figures as granted.

Reasons for the Decision

1. The appeal is admissible.

2. The amendment brought in Claims 5 and 6 is supported by the original description, page 5, lines 6 to 20 and restricts the scope of protection conferred . This amendment therefore satisfies the requirements of Article 123(2) and (3) EPC.

3. Disclosure of the relative viscosity parameter of the process claims (Article 83 EPC)

The Appellant accepts that the determination of relative viscosity is well-known in the art (Letter dated 18 October 1990, page 1, last lines), but only when other conditions are explicitly given. However, the contested patent, in page 5 of its description, refers to a standard procedure, disclosed in the US-A-3 511 815, for determining the relative viscosity of a polymer and specifies that the solvent used for the present determinations is a mixture of formic acid and phenol. The "present determinations" in that context refer to those performed on the polycarbonamide of the example given in the description as granted, at the end of page 5. This example refers the reader to a second document, the Speck US patent (Ibid), which mentions a 1:1 mixture of 90-100% formic acid and phenol. Thus, the solvent and the ratio of the components of this solvent are given. Moreover, the quantity of the polymer to be dissolved in the solvent is 8,4%, as indicated in the already cited US-A-3 511 815, Column 3, lines 52 and 53, and this corresponds to the value given in page 44 of the general technical book, "Man-made fibers", from R.W. Moncrieff, which explains the term "relative viscosity". A test temperature of 25°C is also mentioned in US-A-3 511 815, Column 5, line 51, and in the same book. Thus, it appears that all these conditions are parts of the common knowledge of the person skilled in the art.

Regarding now the polymer to be used, the man skilled in the art knows from the contested Claim 1, that he needs a high molecular weight polymer, which can melt. Column 10, lines 26-31, of the Speck US patent indicates how the molecular weight of a polymer can be increased, a relative viscosity of 27 being said in Column 7 to correspond to a

molecular weight of 9500. Thus, the man skilled in the art knowing that he has to obtain a higher molecular weight polymer is told by this prior art how to obtain it.

It follows that all the informations for determining the relative viscosity, which according to the Appellant are missing, are in fact available directly or indirectly from the description of the contested patent to the skilled person. As regards the objection of the Appellant concerning the allegedly missing essential feature in Claim 1, this objection touches the clarity of Claim 1, which is not a ground of opposition under Article 100 EPC, so that the objection cannot be considered.

4. Obviousness of the process claims

4.1 The closest document to the claimed method is document (3). It relates to a method for impregnating strands of filaments with a quick-setting synthetic resin compound, for example a composition of polyester or polyurethanes resins with a curing agent. The tensioned strands of filaments are drawn in sliding contact with an arcuate surface of an extrusion head over a transverse line of orifices of this head, through which the impregnation fluid is injected onto the strands. The width of the orifices transverse to the direction of movement of the strands is less than the diameter of the unsupported part of the strands, which are pressed onto the apparatus and thus have a tendency to flatten, sealing thereby the orifices. Thus, only a small portion of the surface of each strand comes into contact with its corresponding orifice and hence with the impregnation fluid, so that only the bottom part of the strand is wetted. This corresponds to the object of this prior art, which, contrary to the present invention, aims at avoiding the full coating of the strands while obtaining a good

distribution of the impregnation fluid over the cross-section of the strands.

4.2 In this closest prior art, a polymeric material is applied at low viscosity, since it was thought that such viscosity would help the penetration of the material through the bundles of filaments. However, the product obtained by this method is not uniform, the matrix material either accumulates to form resin-rich areas or leaves voids or resin-poor zones, which have a bad effect on the properties of the product. Moreover, this polymeric material is not suitable for high-speed production, requiring a substantial time to harden.

Thus, one technical problem for the present invention is to provide a method which makes intermediate products having a more uniform distribution and mixing of filaments and matrix material. The Board has no reason to doubt that this object is achieved by the method of the contested Claim 1, since the properties of samples produced by this method and shown in Tables II and III of the patent description support this view. The Appellant has merely asserted that the products obtained show lower strengths than those of the prior art, but has produced no evidence in support, though he has the burden of proof.

4.3 Thus, the method according to the contested Claim 1 differs from the one of document (3) in that:

(a) the material injected trough the extrusion head is a molten thermoplastic polymer having a relative viscosity of at least 50;

(b) the head is pre-heated; and

(c) this material is injected trough a slot, so that air is expelled from the array of filaments and polymeric protrusions are formed on the side of said array opposite from the slot.

4.4 Feature (a) is neither suggested in document (3) nor in any other documents. It is true that the closest prior art teaches quick hardening materials for impregnation, but nevertheless it gives no hint to use molten thermoplastic material having high viscosity. There are two reasons for that: on the one hand, the extrusion head according to this prior art is not heated, - a necessary requirement when molten thermoplastic material is used -, and, on the other hand, the used material is in its liquid form, suggesting thus the idea of low viscosity. It is certainly always the wish of the skilled person to obtain a high strength product. If it was so obvious in such a case to employ a high molecular height material, then previous attempts to do so would have been disclosed.

Document (4) cited by the Appellant, describes a method for wetting or coating individuals filaments with resin. After leaving a heater, the tensioned array of filaments, spread out by means of rollers in order to separate the filaments, is exposed to a flow of resin discharged from a nozzle fixed at a short distance above the said array. Because of the already heated filaments, the viscosity of the resin decreases, so that the resin flows around and between the filaments to eliminate all voids. Thermoplastic or thermosetting plastic resins can be both applied. It shows, and the Board agrees with the Appellant thereon, that these two kinds of plastics are equivalent. Nevertheless, the combination of this teaching with the prior art known from document (3) does not suggest the method according to the contested Claim 1, since the document (4), although aiming to strength the fiber reinforced material, in no way hints at the use of thermoplastics having a high viscosity. The method itself is also different, the filaments having no contact with the injection nozzle.

Thus, features (a) and (c) are neither suggested by document (4) nor by the other cited documents. Document (1), although referring to higher viscosities of thermoplastic resins (Column 1, line 33), when comparing it to the low viscosity thermosetting resins, does not teach any range and makes no statement about the relative viscosity of the polymer used.

4.5 The method step (c) in the claim is not disclosed in any cited document. In particular, it cannot be derived from the closest prior art (3), which, as seen above, wishes to avoid a coating of the filaments and further teaches the provision of orifices, which are sealed by the filaments.

4.6 It is thus concluded that the method of Claim 1 involves an inventive step.

5. Disclosure of the parameter of the product claims

5.1 Even if the L ratio mentioned in the product claims is unusual in this technical field as recognised by the Respondent, it is by no means new. The Respondent has explained that this parameter is known in the automobile painting field, using the Photoscan technique (see the description of the contested patent, page 4 last lines), and was here adopted, since it is the only way to define the product. Thus, it cannot be considered as an unknown parameter.

5.2 This L parameter is to be seen in combination with the feature of the product claims relating to the volume percentage of fiber bundles. With such a percentage (50 to 75%), the symmetrical configurations of fiber bundles depicted by the Appellant during the oral proceedings and in his notice of opposition, page 3, do not correspond to

the claimed invention, since they imply a substantial lower percentage of fibers.

Contrary, also, to the assertion of the Appellant, the value 1.0 for the L ratio is not representative of a perfect uniformity, but shows equivalence of uniformity in the two directions, i.e. in the composite consolidation direction and in the direction perpendicular thereto. As mentioned in the description of the patent in suit (see page 5, line 36), the consolidation direction is the direction of the pressure force during moulding and the distance x, used to measure the mass mean length L, is the length of the matrix resin between the fiber or the fiber bundles (see the description, page 3, lines 4-18). This L value per se shows the presence of voids or of rich resin areas and it is therefore not very important whether the distance x is measured between fibers and/or fiber bundles. The light in the Photoscan technique, in fact, switches as soon as it is dark, thus either with a fiber or with a fiber bundle. The purpose of this value L is essentially to accentuate small differences in fiber distribution.

Therefore, in the view of the Board, the determination itself of the "L" parameter mentioned in the product Claims is sufficiently disclosed and enables the further consideration of its significance.

5.3 The further objection of the Appellant, that the ranges of values given in the Table II of the description show how this parameter is indefinite, is not persuasive. The L values given in this table represent the mean or average of the four values obtained from four photographs (see page 5, lines 15 to 18 of the description) and the results of these values, the L ratio values, are all within the claimed range of 0,5 and 1.0. The deviation values shown

besides these L values are only given for statistic reasons and it is not a realistic approach to take the uppermost and lowermost limits of the L values obtained thereby for proving that the ratio may be outside the claimed range.

5.4 The fact that the best example mentioned in this table, namely example 3, shows a ratio of 0,84 does not mean, as argued by the Appellant, that the present invention cannot reach the upper value of 1.0 of the claimed range. The Appellant himself has demonstrated that this value 1.0 can be reached when an ideal symmetrical configuration in both directions exists. As seen above, a ratio of 1.0 does not mean a perfect uniformity. It would indicate the same uniformity in both perpendicular directions. Moreover, there is not requirement in the European Patent Convention that the patent applicant should show his "best mode". Rule 27(f) EPC requires only one way of carrying out the present invention. There is no evidence that the instructions in the patent would prevent the skilled person from carrying out the invention.

For all these reasons, the Board considers that the L ratio parameter of the product claims does not lead to insufficiency of disclosure and is clearly defined and suitable to characterise the claimed product.

6. Obviousness of the product claim

Dealing with this point during the oral proceedings, so at the latest stage of the appeal proceedings, the Appellant has introduced new lines of argumentation, since he has, for the first time, considered the prior art known from documents (8) or (9) as the closest one for the product claims and alleged obviousness on this basis. These documents, although cited in the description, were not

mentioned by the Opponents neither in the opposition procedure nor previously in the appeal. As repeatedly made clear by the Boards of Appeal (see T 122/84, OJ EPO 1987, 177, points 10 to 13; supplement to OJ EPO 6/1991, 53 to 55), an attempt by either party to take the other by surprise by presenting new arguments or evidence at the last minute without very good reason for this late presentation may constitute an abuse of procedure and is unfair to the other party. The Board is in such a case, entitled under Article 14(2) to disregard these arguments.

However, the Board deems it appropriate in the present case to give brief reasons why it has found these arguments irrelevant.

These documents (8) and (9) disclose a fiber reinforced thermoplastic material having a thermoplastic polymer coating substantially all sides of the filaments in the array to form a composite, said fiber bundles comprising from 20 to 60% by weight. By means of a heated extrusion nozzle located at a certain distance from the fiber layers, the molten thermoplastic resin is fed on or between the layers of pre-heated filaments, which, then, are pressed together between rollers in order to force the melted thermoplastic to coat all sides and to expel the air. The method used in these prior arts is therefore quite different from the one of the present invention and this prior art method gives no suggestion to apply a thermoplastic polymer having a relative viscosity of at least 50 and to form protrusions on the side of the filament array opposite to the nozzle. There is no reason to think that these prior art method produce products according to the product claims of the patent in suit, and the Appellant has not raised the question of novelty. He has, however, objected on the ground of lack of inventive

step in this respect, arguing that the sole difference, namely the uniformity parameter, the ratio L, is only the result of an obvious desideratum.

Previous to the present invention such uniformity was indeed always desired, since thermoplastic materials were reinforced by fibers mainly for strengthening purposes. It was also well known that the strengths of the obtained products would be dependent on the uniform coating and distribution of the fibers, rich resin areas or voids resulting in low strength zones (see D8, page 2, lines 19 to 20). Since the Appellant has not demonstrated that products having the same properties as those obtained by the present invention were or could have been produced by either the method according to documents D8 and D9 or by other prior art methods, it has to be assumed that the present invention provides products with better properties, as alleged by the Respondent.

This assumption is further backed up by the affidavit submitted on the behalf of by the Respondent during the opposition procedure. This document shows a better distribution of the fibers in a sample according to the patent in suit, when compared to a sample of a reinforced thermoplastic article according to the method of document (1), which is similar to those of documents (8) and (9), since the article, once impregnated by the thermoplastic resin, is compressed during cooling between rolls in order to inhibit or avoid the formation of internal voids.

The Respondent has therefore fulfilled a long-felt need, which until the present invention was not satisfied. Thus, the subject-matter of the product claims is not the sole result of an obvious desideratum, once starting from documents (8) or (9). It is the result of a different and

new method, which, as seen above, is inventive, providing products with superior and unexpected properties.

It is thus concluded that the subject-matter of the product claims involves an inventive step in the sense of Article 56 EPC.

Order

For these reasons, it is decided that:

1. The decision of the first instance is set aside.

2. The case is remitted to the first instance with order to maintain the patent on the basis of Claims 1 to 4 as granted, Claims 5 and 6 as amended during the oral proceedings, Claims 7 to 11 as granted, and description and figures as granted.

The Registrar

S. Fabiani

The Chairman

G. Szabo

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