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 102/90 - 3.2.5

Application No.: 84 106 711.9

Publication No.: 0 133 205

Title of invention: Cored yarn as a reinforcement structure

Classification: D02G 3/36

D E C I S I O N
of 20 March 1992

Applicant: E.I. DU PONT DE NEMOURS AND COMPANY

Opponent: HOECHST AG

Headword:

EPC Articles 52, 54 and 56

Keyword: "Novelty (yes)"
"Inventive step (yes)"

Headnote

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Beschwerdekammern | Boards of Appeal | Chambres de recours

Case Number : T 102/90 - 3.2.5

D E C I S I O N
of the Technical Board of Appeal 3.2.5
of 20 March 1992

Appellant : (Opponent)
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Decision under appeal :
Decision of Opposition Division of the European Patent Office dated 5 December 1989 rejecting the opposition filed against European patent No. 0 133 205 pursuant to Article 102(2) EPC.

Composition of the Board :

Chairman : H.J. Seidenschwarz
Members : M.H.M. Liscourt
J.-C. Saisset

Summary of Facts and Submissions

I. By the decision under appeal dated 5 December 1989, the Opposition Division rejected the opposition filed against European patent No. 0 133 205 granted upon the subject-matter of European patent application 84 106 711.9.

II. Claim 1 of the granted patent reads as follows:

"In the reinforcement structure consisting of a core of longitudinally aligned yarn surrounded by a sheath comprising a helical wrapping of yarn, the improvement comprising the use of yarn having a tenacity greater than 10 dN/tex and an initial modulus greater than 200 dN/tex for both sheath and core, the ratio of sheath thickness to the radius of the reinforcement structure being from 0.01 to 0.25, the positioning of the adjacent turns of the helical wrapping to abut and form an angle to the core of between 80 and 90 degrees and the maintaining of the core under at least 0.1% radial compression by means of said sheath".

III. On 6 February 1990 the Appellant (Opponent) appealed against the decision and paid the appropriate fee. A Statement of Grounds was filed on 11 April 1990. The appeal was supported by the following documents already cited in the impugned decision with the corresponding references:

(D1) DE-A-2 853 208
(D2) DE-C-2 743 799
(D3) US-A-4 202 382
(D4) US-A-3 243 338

and by a further document:

(D6) DIN 53840, November 1983.

IV. Oral proceedings were held on 20 March 1992.

(i) The Appellant argues that most of the features of Claim 1 are literally known from document D1 whereas the other features can implicitly be deduced from said document since the given parameters are without any substance for the subject-matter of Claim 1. However if the subject-matter of Claim 1 is still considered as novel, it does not involve an inventive step when considering documents D1 and D4 combined with each other.

(ii) The Respondent (Patentee) contests the arguments of the Appellant and is of the opinion that document D1 does not disclose at least the features concerning the ratio of sheath thickness to the radius of the reinforcement structure, the angle of the adjacent turns of the helical wrapping of the yarn surrounding the core and the radial compression of the core. Furthermore, the person skilled in the art would not consider the teachings of the documents D1 and D4, since the problems to be solved by the known structures are different to the problem to be solved by the subject-matter of the patent in suit and since said documents do not contain any suggestion towards the subject-matter as specified in Claim 1 of the patent as granted.

V. At the end of the oral proceedings, the Appellant maintained his request that the decision of the Opposition Division be set aside and the patent be revoked, and the Respondent requested that the appeal be dismissed and the patent be maintained.

Reasons for the Decision

1. The appeal is admissible.

2. Novelty

2.1 The subject-matter as specified in Claim 1 concerns a reinforcement structure which comprises the following features:

(a) a core of longitudinally aligned yarn;
(b) a sheath comprising a helical wrapping of yarn which surrounds the core;
(c) both sheath and core have a tenacity greater than 10 dN/tex;
(d) both sheath and core have an initial modulus greater than 200 dN/tex;
(e) the ratio of the sheath thickness to the radius of the reinforcement structure is from 0.01 to 0.25;
(f) the positioning of the adjacent turns of the helical wrapping to abut on each other;
(g) the positioning of the adjacent turns of the helical wrapping to form an angle to the core of between 80 to 90 degrees, and
(h) the maintaining of the core under at least 0.1% radial compression by means of said sheath.

2.2 Document D1 (cf. page 9, line 4 to page 10, line 15; page 14, last line to page 15, line 3; Claims 1 and 2, Figures 1 and 4) concerns a filiform textile material which can be used for producing a textile material used in the manufacture of laminated articles. This filiform textile material consists of a core of longitudinally aligned yarn formed by a plurality of resin-pre-

impregnated continuous chemical filaments, and a sheath comprising a helical wrapping of yarn formed by continuous chemical filaments (cf. above section 2.1: features (a) and (b)). According to one of the disclosed embodiments, the helix of the wrapping can have continuous turns (cf. above section 2.1: feature (f)). However, Figure 1 shows that only a part of the core (1) is encircled by substantially continuous turns of the helical wrapping (2) which form an angle to the core of about 90 degrees. The description of the embodiments is silent on the wrap angle and on the radial compression of the core along the whole length of the wrapped core (cf. above section 2.1: features (g) and (h)).

Furthermore, the yarns used for the core and sheath can be as in the reinforcement structure of the patent in suit inorganic fibres, for example glass fibres, carbon fibres, etc. which may have therefore implicitly a tenacity and an initial modulus as defined in Claim 1 of the patent in suit (cf. above section 2.1: features (c) and (d) and the European patent specification 0 133 205: page 2, lines 4 to 6). According to the correct calculation by the Respondent, which was not contested by the Appellant, the ratio of the helical wrapping thickness to the radius of the whole structure is 0.488, which is far above of 0.01 to 0.25 as defined in Claim 1 (cf. above section 2.1: feature (e)).

Consequently the subject-matter of Claim 1 of the patent in suit differs from the known reinforcement structure in the features (e), (g) and (h) as specified in above section 2.1.

2.3 None of the further available documents discloses a reinforcement structure according to Claim 1; since this was no longer disputed during the oral proceedings by the

Appellant there is no need for further detailed substantiation of this matter.

Therefore, the subject-matter of Claim 1 is novel within the meaning of Article 54 EPC.

3. Inventive step

3.1 It follows from the statement in the foregoing section 2 that document D1 reflects the prior art which is closest to the subject-matter of Claim 1 of the patent in suit. A number of yarns used for such a reinforcement structure are made of organic or inorganic fibres and have tenacities in excess of 10 dN/tex, as these yarns provide the tensile strength of the reinforcement structure. However, when said reinforcement structure goes through compression-decompression cycles during use, the axially compressed core has considerable hysteresis losses. Therefore, it is believed that the compressive strengths of such yarns may have restricted their use as reinforcement in structural composite applications (cf. European patent specification 0 133 205: page 2, lines 4 to 9, 30 to 32 and 44 to 46).

3.2 The problem to be solved is therefore to provide structures of such yarns wherein compressive strength is enhanced with minimal reduction in tensile strength.

3.3 According to the teaching of Claim 1 of the patent in suit, the problem is solved by the combination of the features (a) to (b) and (f) known from document D1 with the features (e), (g) and (h) as specified in above section 2.1.

The maintenance of at least 0.1% radial compression along the length of the core by the means of the helical

wrapping (feature (h)) provides the core with the radial restraint which is necessary to enhance the axial compressive strength of the reinforcement structure in addition to high tensile strength by reducing the hysteresis losses.

The high helical wrapping angle of between 80 and 90 degrees (feature (g)) provides the necessary containment of the core and permits the fullest use of the wrap in providing radial compression. In this way the sheath component prevents lateral plastic flow and bulking when the reinforcement structure is subjected to high compression loads.

The ratio of sheath thickness to the radius of the reinforcement structure being from 0.01 to 0.25 (feature (e)) permits maintenance of the sheath thickness at a minimum with respect to the whole reinforcement structure since the wrapping yarn of the sheath adds little or no tensile strength to the reinforcement structure and in fact reduces the tenacity of said reinforcement structure. However, this radius ratio still enables the winding of the wrapping yarn around the core under high tension without breaking thus providing the core with that radial compression and restraint which the reinforcement structure needs when it is subjected to high compression loads.

3.4 From document D1 (cf. page 8, line 19 to page 9, line 3) it is known to produce resin-preimpregnated textile material which has a substantially smooth outer surface and a resistance to splitting off between the layers formed which resistance is limited due to this surface state. Therefore, it is the purpose of the resin-preimpregnated reinforcement structure as disclosed by document D1 to make it possible to easily store the

preimpregnated material and to obtain a very good bond between the textile reinforcing material and the resin in the finished laminated article.

The paragraphs of this document D1 cited by the Appellant during the oral proceedings, namely page 10, paragraph 4, and page 16, paragraphs 3 and 5 concern the titre of the wrapping yarn which is well below that of the yarns of the core, and the rigidity and the better resistance to splitting off of the laminated articles produced from the preimpregnated reinforcement structure as disclosed by said document D1.

From the above follows that in document D1 is no reference to the problem to be solved which underlies the subject-matter of Claim 1 of the patent in suit. Therefore, the Appellant's opinion that the problem to be solved by the subject-matter of document D1 is identical with said problem of the present invention is not justified.

According to the teaching of document D1, the core of the preimpregnated reinforcement structure consists of a plurality of non-polymerised or partly polymerised, resin-preimpregnated individual yarns, which is wrapped with at least one layer of non resin-impregnated textile material. In document D1 there is however no hint to the importance of the compression strength for the core and to an improvement of said compressive strength.

3.5 Document D4 discloses a reinforcement structure (1) which comprises a core of longitudinally aligned yarns and a sheath having at least two layers of helical wrapping yarns (3, 4) which surrounds the core. The positioning of the adjacent turns of the helical wrappings is such that the adjacent turns do not abut and form an angle to the core of at least 40 degrees. The only embodiment shows

that the angle is maximal of 75 degrees with respect to the longitudinal axis of the cord (cf. Column 2, lines 24 to 27, 54 to 60; Claim 1; Figure 1).

According to the description (Column 1, lines 51 to 56), the resistance of the yarns to compression is closely allied to the increase in stiffness in the reinforcement structure. Therefore, in applications where stiffness is required in the reinforcement structure, this is enhanced

- by increasing the size of the core and of the yarns which make up the core;
- by arranging the yarns so that the core is substantially circular in cross-section;
- by minimizing the twist of the yarns of the core,
- by increasing the binding effect of the helical wrapping for instance by increasing the tension in the wrapping yarn, and
- by increasing the number of the wrapping yarn.

From the above it is clear that it is known to the person skilled in the art that the compressive strength of the core of the reinforcement structure can be influenced by means of the sheath, e.g. by increasing the tension in the wrapping yarn. However, the importance of the ratio of sheath thickness to the radius of the reinforcement structure from 0.01 to 0.25 and of a wrap angle between 80 and 90 degrees for maintaining of the core under at least 0.1% radial compression has been not recognised in document D4. It does not contain any hint in this respect. Due to this fact, the teaching of document D4 therefore cannot support the Appellant's submission that this document discloses the combination of the features (e), (g) and (h) of Claim 1 of the patent in suit as specified in above section 2.1 in such a obvious manner that the person skilled in the art can add these features without

any inventive step to the teaching according to document D1.

3.6 The Board has also considered the further available documents and has found them non-prejudicial to the subject-matter of Claim 1, either alone or in combination with the documents cited above.

4. For these reasons given above, the subject-matter of Claim 1 involves an inventive step within the meaning of Article 56 EPC. Claims 2 to 9 are dependent upon Claim 1 and are therefore also patentable. The patent can thus be maintained with these claims.

Order

For these reasons, it is decided that:

The appeal is dismissed.

The Registrar: The Chairman:

A. Townend H.J. Seidenschwarz