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D E C I S I O N
of 26 September 2002

Case Number: T 0628/97 - 3.2.5

Application Number: 91202318.1

Publication Number: 0476752

IPC: B29B 15/12

Language of the proceedings: EN

Title of invention:

Process and apparatus for resin impregnation of a fibrous substrate

Patentee:

Resolution Research Nederland B.V.

Opponent:

VITS-Maschinenbau GmbH
Bakelite AG

Headword:

-

Relevant legal provisions:

EPC Art. 54, 56, 123(2)

Keyword:

"Addition of subject-matter, main request (no)"
"Novelty, inventive step, main request (yes)"

Decisions cited:

-

Catchword:

-



Case Number: T 0628/97 - 3.2.5

D E C I S I O N
of the Technical Board of Appeal 3.2.5
of 26 September 2002

Appellant: Resolution Research Nederland B.V.
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Representative: van der Straaten, Jan Anthony
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Respondent I: VITS-Maschinenbau GmbH
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Representative: Frese-Göddeke, Beate, Dr.
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Respondent II: Bakelite AG
(Opponent 02) Patentabteilung
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Representative:

Decision under appeal: Decision of the Opposition Division of the
European Patent Office posted 15 April 1997
revoking European patent No. 0 476 752 pursuant
to Article 102(1) EPC.

Composition of the Board:

Chairman: W. Moser
Members: W. R. Zellhuber
W. Widmeier

Summary of Facts and Submissions

- I. The appellant (patent proprietor) lodged an appeal against the decision of the Opposition Division revoking the European patent No. 0 476 752.
- II. Oppositions were filed against the patent as a whole and based on Article 100(a) EPC (lack of novelty, Article 54 EPC, and lack of inventive step, Article 56 EPC). The Opposition Division held that the ground for opposition of lack of inventive step prejudiced the maintenance of the patent having regard to the documents
- V1: AT-B 356 390 and
V2: US-A 2 199 228.
- III. Further on, in the appeal procedure, the following documents have been referred to:
- V3: DE-C 36 10 943;
V4: CH-B 535 074;
V5: Ullmanns Encyklopädie der technischen Chemie; 4., neubearbeitete und erweiterte Auflage; Band 14, "Keramische Farben bis Kork"; Verlag Chemie, Weinheim, New York, 1977; pages 244 to 247;
V6: Encyclopedia of Polymer Science and Engineering, Volume 3, "Cellular Materials to Composites", John Wiley & Sons, New York, Chichester, Brisbane, Toronto, Singapore, 1985, pages 552 to 562;
V7: Carl Hanser-Verlag, München 1989, Kunststoffe 79 (1989) 3, "Anlagen zum Herstellen von Prepreg", pages 221 to 224;

- V8: Clyde F. Coombs, Jr, "Printed Circuits Handbook", McGraw-Hill Book Company, third edition, 1988, pages 6.3 to 6.5;
- V9: Brochure by Dow Plastics, "Formulating With DOW Epoxy Resins - Electrical Laminates", February 1990
- V10: US-A 4 767 643;
- V11: DE-A 29 17 170;
- V12: US-A 4 886 684
- V13: Plastiques Flash, décembre 1979, "Les techniques d'enduction sur supports souples", pages 39 to 43;
- V14: Kunststoffberater 1/2/1988, "Fachbeitrag - Technologie der Rakel-, Siebkopf- und Walzenauftragssysteme (Teil I)", pages 39 to 45.

IV. The appellant requested that the decision under appeal be set aside and that the patent be maintained on the basis of the following documents:

- (i) main request:
 - (a) claims 1 to 13 filed as main request on 3 June 2002;
 - (b) description, pages 2a, 2b, 3, 7 and 8 filed as main request on 3 June 2002, pages 4 to 6 and page 9, lines 1 to 25 as granted;
 - (c) drawings, Figures 1 to 3 as granted; or
- (ii) first auxiliary request:
 - (a) claims 1 to 12 filed as first auxiliary request on 3 June 2002;
 - (b) description, pages 2a, 2b, 3, 7 and 8 filed as first auxiliary request on

- 3 June 2002, pages 4 to 6 and page 9,
lines 1 to 25 as granted;
- (c) drawings, Figures 1 to 3 as granted; or
- (iii) second auxiliary request:
- (a) claims 1 to 11 filed as second auxiliary request on 3 June 2002;
 - (b) description, pages 2a, 2b, 3, 7 and 8 filed as second auxiliary request on 3 June 2002, pages 4 to 6 and page 9, lines 1 to 25 as granted;
 - (c) drawings, Figures 1 to 3 as granted.

The appellant further requested that oral proceedings be held in case the Board would consider dismissal of the appeal.

- V. The respondents I and II (opponents 01 and 02) requested that the appeal be dismissed.
- VI. Independent claims 1 and 11 of the main request read as follows:

"1. A process for the preparation of prepregs, comprising a fibrous substrate impregnated with a partially cured thermosettable resin, by impregnating the fibrous substrate with a solventless thermosettable resin composition, the process comprising:

- (a) providing resin application means comprising a rotating applicator roll (4);
- (b) applying to said rotating applicator roll (4) a liquid form thermosettable resin composition comprising an essentially uncured thermosettable resin;
- (c) passing a fibrous web (6), having first and second

web surfaces, in contact with said thermosettable resin composition on said rotating applicator roll (4), so as to transfer said thermosettable resin composition to the first surface of said fibrous web (6);

- (d) passing the resulting resin-containing web to a heating zone maintained at a temperature effective to partially cure said thermosettable resin,

characterized in that preregs for electric or electronic circuit boards are prepared by:

- (i) applying a liquid solventless thermosettable resin composition to the applicator roll (4) by means of a combination of a set gap roll (8) and a nozzle (7), capable of applying a controlled quantity of liquid resin to the rotating surface of the applicator roll (4), wherein the liquid-form, solventless thermosettable resin composition, comprises an essentially uncured thermosettable resin, a curing agent and optionally an accelerator, and having a viscosity in the range of from 0.05 to 1.0 Pa.s, in the absence of a vessel for maintaining the resin system in a standing bath prior to application of said resin composition to the fibrous web,
- (ii) passing the fibrous web (6), in countercurrent contact with said resin composition on said rotating resin applicator roll (4) so as to transfer said resin composition to the first surface of said fibrous web and thence to the interior thereof, said transfer being carried out in the absence of external pressure applied to said second web surface opposite the area of resin transfer to said first web surface."

"11. An apparatus for impregnating a fibrous web (6) with a thermosettable resin composition, which

apparatus comprises a resin applicator roll (4), means for controlling the speed of the resin applicator roll (4), a resin delivery system for continuously applying the resin composition to the resin applicator roll (4), characterized in that it comprises a set gap roll (8) arranged near the resin applicator roll (4) and means for rotating the set gap roll (8), means for advancing a fibrous web (6) in contact with the resin applicator roll in a direction which is opposite to the rotation of the resin applicator roll (4), and means for maintaining sufficient tension in the fibrous web (6) to enable the fibrous web (6) to absorb resin composition from the resin applicator roll (4), said tension-maintaining means positioned so as not to apply pressure to the opposite surface of said fibrous web (6) as the web contacts the thermosettable resin on the applicator roll (4) surface, wherein the resin delivery is carried out at volume rates synchronized with the speed of the moving web so as to deliver a predetermined volume of resin to the web and to minimize residence time within the resin delivery system, including a temperature controlled static blender or a mixing extruder with an outlet into a nozzle (7), which is capable of applying a controlled quantity of liquid resin to the rotating surface of the applicator roll (4), and in that the set gap roll is so positioned that it is located between the nozzle (7) and the zone where the advancing web is in contact with the resin film on the resin applicator roll (4)."

VII. The appellant argued essentially as follows:

In current commercial processes for preparing prepreps, resin had been applied to the substrate using an organic solution of the resin. The significance of the

invention according to the patent in suit was that a process and an apparatus had been developed which permitted saturation of a fibrous web with a solventless resin without the use of a resin bath in the preparation of an electrical prepreg.

That aim was achieved by a process according to claim 1 of the main request and an apparatus according to claim 11 of the main request, in particular, in that a fibrous web was impregnated with a solventless curable thermosetting resin composition comprising the thermosettable resin, a curing agent and optionally an accelerator, wherein the resin composition had a sufficient low viscosity to be applied in a fast and efficient way by rotating rolls and without a direct contact with a stock of the thermosettable resin composition.

The prior art neither disclosed nor suggested such a process or such an apparatus.

Document V1 related to preimpregnation of paper wherein an applicator roller was rotated in a standing bath containing a resin solution. A resin bath was also suggested in documents V3, V4, V7, V8, V9, V10, V11, V13 and V14.

Document V2 concerned paper coating rather than resin impregnation. Document V5 related to a different technique, namely to the application of glue. Figure 6 of document V5 showed a roll-coating system wherein, contrary to the patent in suit, pressure was applied to the surface opposite to the applicator roller. The same applied to the nip-fed reverse roll-coating system disclosed in Figure 17 of document V6.

Document V12 disclosed a prepreg preparation process wherein a resin film was applied to a release film, and rovings, fabrics or a web were introduced into the resin film. Any system of rotating rolls for efficient and fast application of a mixture of resin and curing agent on a fibrous web, before the occurrence of any significant gelling or initial curing, was neither disclosed nor suggested.

VIII. Although duly invited to file observations in respect of the patent in suit as amended during the appeal proceedings, the respondents filed their observations only with respect to the subject-matter of the claims filed by the appellant together with the statement setting out the grounds of appeal.

Respondent I argued essentially as follows:

The process according to the patent in suit did not involve an inventive step having regard to a combination of the teachings of documents V1 and V2 or documents V1 and V3. A person skilled in the art would apply solventless resin compositions in the same way as disclosed in document V1. The feature of applying a resin composition in the absence of a resin bath was without any significance, because document V2, cf. Figures 1 and 5 and document V3, cf. Figure 2, both disclosed a process without using a bath. Moreover, in the application as filed, that feature had not been disclosed as representing a part of the invention.

Respondent II argued essentially as follows:

Document V12, which was referred to for the first time

in the appeal proceedings, disclosed a process for the preparation of prepregs wherein a solventless resin composition was applied to a fibrous web. Document V7 disclosed the so-called reverse-roll-coating process for impregnating fibrous webs. Thus, the process of manufacturing prepregs with solventless and thermosettable resins as well as the reverse-roll-coating process for applying coatings with rollers in the absence of a resin bath had been known. Further embodiments of the reverse-roll-coating technology were disclosed in documents V13 and V14. Accordingly, the subject-matter of the patent in suit did not involve an inventive step.

Reasons for the Decision

Main request

1. *Allowability of the amendments*

The subject-matter of claim 1 is disclosed in the printed version of the application as filed in claim 1 in connection with the following passages of the description; the respective features of claim 1 are added in brackets:

- page 2, lines 4 to 7 ("preparation of prepregs for electric or electronic circuit boards...");
- page 3, lines 12 to 18 ("... solventless ...");
- page 3, lines 42 to 57 (".. rotating applicator roll...", "... combination of a set gap roll and a nozzle capable of applying a controlled quantity of liquid resin to the rotating surface of the applicator roll ...");

- page 3, lines 16 to 17 and page 7, lines 42 to 43 ("... comprises ... a curing agent and optionally an accelerator...");
- page 4, lines 35 and 36 and page 7, line 57 ("... viscosity in the range of from 0.05 to 1.0 Pa.s...");
- page 2, line 29 and Figure 2 ("... in the absence of a vessel for maintaining the resin system in a standing bath ...").

The subject-matter of dependent claims 2, 3, 5 and 10 is disclosed on page 2, line 5, page 7, line 58 to page 8, line 3 and page 7, lines 34 and 35, respectively, of the printed version of the application as filed.

Dependent claims 4 and 6 to 9 correspond to claims 3 to 7 of the application as filed.

The subject-matter of claims 11 to 13 is disclosed in claims 1, 10 and 12, and on page 3, line 42 to page 4, line 6, on page 4, lines 44 to 54, and in Figure 2 of the printed version of the application as filed.

The description was amended to bring it in line with the subject-matter of the claims 1 and 11. A reference to document V1 was added. The drawings correspond to the drawings of the application as filed.

In the Board's judgement, the amendments had been made in accordance with the requirements of Article 123(2) EPC.

Furthermore, the scope of protection conferred by independent claims 1 and 11 is more limited than that

of the corresponding independent claims 1 and 10 of the patent in suit as granted.

The patent in suit as amended thus meets the requirements of Article 123(2) and (3) EPC.

Furthermore, in the Board's judgement, claims 1 to 13 also meet the requirements of Article 84 EPC.

2. *Novelty*

None of the cited documents discloses a process according to claim 1, in particular, a process wherein a liquid solventless thermosettable resin composition comprising a resin and a curing agent is applied to an applicator roll by means of a combination of a set gap roll and a nozzle.

Furthermore, the cited prior art does not disclose an apparatus according to claim 11, in particular, an apparatus comprising an applicator roll in combination with a set gap roll and a nozzle means and means for carrying out resin delivery at volume rates synchronized with the speed of the moving web.

The subject-matter of independent claims 1 and 11 is therefore novel within the meaning of Article 54 EPC.

3. *Inventive step*

- 3.1 Document V1, which represents the closest prior art, discloses a method for the impregnation of a fibrous web wherein a resin composition comprising a solvent is applied to the fibrous web using an applicator roll, the latter being in contact with a bath containing the

resin composition.

- 3.2 The problem underlying the present invention may be seen in providing a process for the impregnation of a fibrous web wherein the disadvantages stemming from the use of a solvent, eg. environmental problems, voids and irregularities in the prepregs, and a time-consuming solvent removal step, are avoided, cf. page 2, lines 17 to 24 of the patent in suit as granted.
- 3.3 The problem is solved by a process according to claim 1 and by an apparatus according to claim 11, respectively.

According to claim 1, a liquid solventless thermosettable resin composition is applied to an applicator roll by means of a combination of a set gap roll and a nozzle in the absence of a vessel for maintaining the resin composition in a standing bath. That composition has a viscosity in the range of from 0.05 to 1.0 Pa.s and comprises a resin and a curing agent. The transfer of the resin composition from the applicator roll to the fibrous web is carried out without applying external pressure to the opposite web surface area.

A further essential feature of claim 11 is that the apparatus comprises means such that the resin delivery is carried out at volume rates synchronized with the speed of the moving web so as to deliver a predetermined volume of resin to the web and to minimize residence time within the resin delivery system.

- 3.4 The cited documents do not suggest such a process or

such an apparatus.

- 3.4.1 As already mentioned above, document V1 suggests impregnating a web with a composition comprising a resin and a solvent, cf. page 3, lines 47 to 49 and page 4, line 9.
- 3.4.2 Document V2, cf. page 1, column 2, lines 4 to 31 and Figure 1, concerns a method for coating paper with a suspension of mineral pigments wherein the suspension is applied to an applicator roll via a spray pipe and a roll comprising indentations, and therefrom to the paper web without applying external pressure to the opposite web surface area. Excess coating is caught in a pan 10 and is pumped therefrom back to the spray pipe, cf. page 1, right column, lines 7 to 9. In lieu of spraying the coating upon the indented roll, the composition may also be fed to the pan 10, and the latter is raised so as to immerse the roll 12, cf. page 2, left column, lines 44 to 47.

Document V2 does not concern a process of impregnating a fibrous web with a solventless composition, and it is silent about the problems arising from the application of a solventless, thermosettable resin composition comprising a resin and curing agent. Consequently, there is no suggestion that a coating device as shown in Figure 1 might be suitable for the application of a solventless resin composition to a web in a process for the preparation of prepregs for electric or electronic circuit boards.

- 3.4.3 Documents V3, V4 and V11 disclose coating methods using a standing bath, cf. Figure 1 ("Schale 8") and Figure 2 ("Zwickel 19") of document V3, Figure 1 of document V4

("Trog 24"), and document V11, page 8, Example 1.

- 3.4.4 Document V5, cf. page 246, Figure 6, concerns a reverse roll coating process for applying glue to a substrate. Document V6 discloses pan-fed and nip-fed reverse roll coaters, cf. page 562. Further reverse roll systems are shown in documents V13, page 41, Figure VI, and document V14, page 41, Figure 6. However, there is no suggestion in these documents of using such a reverse roll coating system for applying a solventless resin composition. Furthermore, these documents suggest neither an applicator roll in combination with a set gap roll and a nozzle, nor the feature that the transfer of the resin composition is carried out in the absence of external pressure applied to the web surface opposite the area of resin transfer to the other web surface.
- 3.4.5 Documents V7, V8 and V9 disclose methods for the preparation of prepregs, wherein a resin composition is applied to a fibrous web. However, that resin composition is either a hotmelt resin, which may be applied by means of a reverse roll system, cf. document V7, page 222, Figure 4 C), or comprises a solvent. In the latter case, a standing bath is used into which the web to be impregnated is immersed, cf. document V7, page 222, Figure 4 A) and B), document V8, page 6.5, Figures 6.4 and 6.5, and document V9, page 3, Figure 1.
- 3.4.6 Documents V10 and V12 disclose methods for impregnating a fibrous sheet with a solventless resin. However, they suggest application devices different from that of the patent in suit. Document V10 suggests passing a fibrous sheet material into a resin bath containing a

solventless composition, cf. abstract, and column 1, lines 50 to 53, and the drawing. Document V12 suggests an impregnation process wherein a resin composition is applied to a release film by means of a resin application device, eg. a doctor blade. Rovings and woven fabrics are introduced into this resin film, cf. column 2, lines 54 to 68.

3.4.7 Moreover, none of the cited documents suggests an apparatus wherein the resin delivery is carried out at volume rates synchronized with the speed of the moving web so as to deliver a predetermined volume of resin to the web and to minimize residence time within the resin delivery system, including a temperature controlled static blender or a mixing extruder with an outlet into a nozzle, which is capable of applying a controlled quantity of liquid resin to the rotating surface of the applicator roll.

3.4.8 To sum up, there is no suggestion in the cited prior art which may render obvious the subject-matter of claims 1 and 11. Therefore, the subject-matter of claims 1 and 11 of the main request involves an inventive step within the meaning of Article 56 EPC. The subject-matter of claims 2 to 10, 12 and 13, which are appendant to claim 1 and claim 11, respectively, similarly involves an inventive step.

4. The main request of the appellant is therefore allowable. Consequently, the auxiliary requests of the appellant had not to be considered.

Under the circumstances, oral proceedings could be dispensed with.

Order

For these reasons it is decided that:

1. The decision under appeal is set aside.
2. The case is remitted to the first instance with the order to maintain the patent on the basis of the following documents:
 - (a) claims 1 to 13 filed as main request on 3 June 2002;
 - (b) description, pages 2a, 2b, 3, 7 and 8 filed as main request on 3 June 2002, pages 4 to 6 and page 9, lines 1 to 25 as granted;
 - (c) drawings, Figures 1 to 3 as granted.

The Registrar:

The Chairman:

M. Dainese

W. Moser