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D E C I S I O N
of 6 June 1994

Case Number: T 0443/91 - 3.3.3

Application Number: 85902649.4

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Title of invention:
Thermosetting resin composition

Applicant:
Mitsui Petrochemical Industries, Ltd.

Opponent:
-

Headword:
-

Relevant legal norms:
EPC Art. 54, 56

Keyword:
"Novelty (affirmed) - after amendment"
"Inventive step (affirmed) - after amendment"

Decisions cited:
-

Catchword:
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Boards of Appeal

Chambres de recours

Case Number: T 0443/91 - 3.3.3

D E C I S I O N
of the Technical Board of Appeal 3.3.3
of 6 June 1994

Appellant: Mitsui Petrochemical Industries, Ltd.
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Decision under appeal: Decision of the Examining Division of the
European Patent Office dated 11 October 1990
refusing European patent application
No. 85 902 649.4 pursuant to Article 97(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 application No. 85 902 649.4, filed on 28 May 1985, having a priority date of 28 May 1984 derived from Japanese Application No. 108131/84, and published under the publication No. 0 182 919, was refused by a decision of the Examining Division dated 11 October 1990. This decision was based on a set of 6 claims filed on 10 April 1990, of which Claim 1 (after correcting the spelling of the word "polyglycidyl" in the last line but two) was in the following form:

"A thermosetting resin composition comprising a pre-reacted product (a) of a polyamino compound, an unsaturated bismaleimide compound, and a curing agent, characterised in that

- (i) the resin consists essentially of the pre-reacted product (a) dissolved in a vinyl compound (b) containing an epoxy group selected from glycidyl acrylate, glycidyl methacrylate and allylglycidyl ether, or a combination of the vinyl compound (b) and an aliphatic epoxy compound (b') having no vinyl group selected from ethylene glycol diglycidyl ether, propylene glycol diglycidyl ether and pentaerythritol polyglycidyl ether, and
- (ii) as catalyst a combination of an epoxy curing agent (c) and a radical polymerisation initiator (d)."

Claims 2 to 5 concerned variations of the proportions of the ingredients, whereas Claim 6 referred to a product obtained from the composition of any of Claims 1 to 5.

II. The ground for the decision was lack of novelty of the subject-matter of the main claim having regard to the disclosure of DE-A-3 030 111 (D1). More specifically, it was stated that D1 disclosed thermosetting resins composed of cyanate esters falling within the scope of component (c), an acrylic or methacrylic epoxy ester, glycidyl methacrylate being used in all the examples of D1, and specifically mentioned as component (b) of the claim under consideration; furthermore a prepolymer (i.e. pre-reacted product) of a maleimide and an amine, which prepolymer corresponds to component (a). Catalysts for the thermosetting resin composition were disclosed at pages 14 and 15 of D1, including the peroxy and azo compounds mentioned at page 8 of the application as examples of compound (d), so that all the features were thus disclosed. As to the possible presence of any inventive step, if novelty were to be established, it was pointed out that the submission that the resin of the subject-matter of the application had superior physical properties to that of D1 might warrant acknowledgement of an inventive step, but only in respect of the preferred embodiments, provided the allegedly superior properties were clearly established, and shown to be attributable to specific distinguishing features of the main claim.

III. An appeal against that decision was lodged on 7 December 1990, the appeal fee was paid on the same day, and the Grounds of Appeal were filed on 18 February 1991. With its Statement of Grounds of Appeal, the Appellant filed a revised set of claims numbered 1 to 5, of which Claim 1 read as follows:

"A thermosetting resin composition comprising

(A) the reaction product of a polyamino compound and an unsaturated bismaleimide

- (B) a liquid component and
- (C) a curing system comprising an epoxy curing agent

characterised in that the reaction product (A) is in solution in the liquid component (B)

further characterised in that the liquid component (B) consists of

- (i) a vinyl epoxy monomer selected from glycidyl acrylate, glycidyl methacrylate and allyl glycidyl ether or
- (ii) a combination of a vinyl epoxy monomer (i) together with an aliphatic epoxy monomer selected from ethylene glycol diglycidyl ether, propylene glycol diglycidyl ether and pentaerythritol polyglycidyl ether or
- (iii) a vinyl epoxy monomer (i) or a combination (ii) together with a styrene type monomer

and further characterised in that the curing system C comprises a radical polymerisation initiator and an epoxy curing agent selected from aliphatic amines, acid anhydrides, dicyandiamide, hydrazines, imidazoles and amine complexes of boron trifluoride."

The Appellant argued that taking the specific disclosure of D1, there was no anticipation of the new Claim 1 by any of the 5 examples of D1, so that novelty could not be denied. As to the existence of an inventive step, it was pointed out that the present application related to thermosetting resin compositions of the "solventless" type. The presence in compositions of this kind of usual organic solvents led to handling difficulties and hazards which the Appellant had successfully avoided by using liquid monomers, i.e. component (B), to dissolve the reaction products (A). Careful selection of the components, and its curing system, had made it possible

to develop solventless thermosetting resin compositions which were particularly easily handled and surprisingly advantageous, in that they had good heat resistance, and low shrinkage on curing.

D1 made a passing reference to solid curable compositions, liquid curable compositions, and solutions of the compositions in the solvents, but there was no indication as to how such compositions were to be prepared. The Examples all related either to solids, or to solutions in solvents such as methyl ethyl ketone and N,N-dimethylformamide. Therefore, D1 offered the skilled worker no incentive towards the adoption of the compositions of the application.

- IV. Pursuant to communications from the Rapporteur, the Appellant, by its letters of 21 September and 17 November 1993, and a telephone conversation on 26 November 1993, replaced the word "comprising" in line 1 of Claim 1 by the words "consisting essentially of", and the word "comprises" in the definition of the curing system C at the end of Claim 1 by the words "consists of".
- V. The Appellant requested that the decision under appeal be set aside, and that a patent be granted on the basis of Claim 1 as set out in paragraph III with the amendments mentioned in paragraph IV above, together with dependent Claims 2 to 5 filed together with the Statement of Grounds of Appeal, and also requested that as the issue of inventiveness had not been dealt with fully by the Examining Division, that issue should either be referred back to the Examining Division or dealt with by the Board. Amended pages of the description adapted to the above-mentioned claims were

sent under cover of a letter dated 17 May 1994, with the result that the description finally considered by the Board consisted of the following:

Pages 1, 2, 2a and 3 to 8 inclusive filed on 16 March 1994 under cover of a letter of 15 March 1994;

Page 9 filed on 17 May 1994 under cover of a letter of the same date;

Pages 10 and 11 filed on 16 March 1994 under cover of a letter of 15 March 1994;

Page 12 filed on 17 May 1994 under cover of a letter of the same date;

Page 13 as originally filed;

Page 14 as filed on 14 November 1988 under cover of a letter of 11 November 1988;

Page 15 as originally filed;

Pages 16 and 17 as filed on 17 May 1994 under cover of a letter of the same date;

Page 18 as originally filed;

Page 19 as filed on 14 November 1988 under cover of a letter of 11 November 1988;

Pages 20 and 21 as filed on 17 May 1994 under cover of a letter of the same date.

Reasons for the Decision

1. The appeal is admissible.
2. *Admissibility of amendments*
 - 2.1 As compared with Claim 1 in the application as filed, the claim now before the Board relates to a composition consisting essentially of components (A), (B), and (C), each of which is more closely defined than before. (A) is now defined as being a reaction product of certain groups of compounds, which is in solution in component (B). (B) is defined as being (i) a vinyl epoxy monomer selected from a group of three identified compounds, or (ii) a combination of those three with an aliphatic epoxy monomer selected from another three named compounds, or (iii) a combination of (i) or (ii) with a styrene type monomer. (C) is defined as being a curing system consisting of a radical polymerisation initiator and an epoxy curing agent selected from six groups of compounds.
 - 2.2 Having regard to the contents of the application as filed, the Board is satisfied that these limitations to Claim 1 are all admissible. The feature of component (A) being in solution in component (B) is disclosed in the passages at page 6, line 33 to page 7, line 4 and page 9, lines 9 to 10, together with page 10, lines 14 and 15 (in relation to the aliphatic epoxy compounds possibly included in the liquid component) and page 7, lines 23 to 25 (in relation to the styrene type monomer which may also optionally be included in the liquid component). Of the three possibilities concerning the liquid component (B), (i) corresponds to the disclosure of Claim 2 of the application as filed, (ii) is disclosed in the passage from page 9, line 25 to

page 10, line 10, while (iii), the optional inclusion of a styrene type monomer is disclosed on page 7, lines 16 to 26. The groups of compounds which now define component (C) are disclosed at page 7, lines 28 to 33 of the application as filed. Accordingly, the Board is satisfied that these amendments are admissible for the purposes of Article 123(2) EPC.

3. *Clarity of Claim 1*

The substitution of the term "comprising" in part (A) of Claim 1 by "consisting essentially of" was necessary to meet the requirement of clarity imposed by Article 84 EPC. Otherwise, the claim in its previous form would be infringed by a composition consisting of 99% of a further component (D), and only 1% of the essential components of the present alleged invention. In contrast, the term "consisting essentially of" allows for the possible presence of such further components as impurities, conventional additives, or even conventional fillers, depending on the art in question. There are some circumstances where the term "comprising" may be used, such as when defining an invention relating, not to the totality of the composition, but instead to one essential component, e.g. in such wording as "comprising X as a stabiliser", (see T 472/88 (10 October 1990) not reported in OJ EPO but reported in 1991 EPOR 486).

4. *Novelty*

The Board is essentially in agreement with the views expressed in paragraphs 13 to 17 of the Statement of Grounds of Appeal, in which the Appellant set out detailed reasoning why the compositions of each of the 5 examples of D1 do not affect the novelty of the compositions as now claimed. It is clear from the general disclosure of D1, as is reflected in particular

by its independent Claims 1 and 7, and equally from its Examples 1 to 5, that an essential feature of its disclosure is the presence of cyanate esters. Although the Examining Division rightly observed that cyanato compounds could be embraced by the catalyst system as defined in Claim 1 as it then stood, now that component (C) is limited to certain defined classes of compounds, that possibility has been excluded. Consequently, the Board is satisfied that the objection of lack of novelty has been overcome, and that therefore the subject-matter of Claim 1 is novel within the meaning of Article 54 EPC.

5. *The closest prior art*

The Board regards D1 as being the closest prior art, although reference was also made by the Examining Division to documents (2) and (3) (FR-A-2 201 313 and FR-A-2 355 047), which are now acknowledged in the description. D1 relates to a class of thermosetting resins which can be used in making coatings, adhesives, moulded components, laminates, etc. (sentence bridging pages 16 and 17), curing being effected by heating in a temperature range of 100 to 250°C depending on the actual composition chosen (page 16 para. 2). Prior to setting, the product may take the form of a powder, as is exemplified in Examples 1 and 2, or it may take the form of a fluid composition attained by the inclusion of a solvent (Examples 3, 4 and 5). The solvents used in those examples are methyl ethyl ketone in Examples 3 and 5, and a mixture thereof with N,N-dimethyl-formamide in Example 4.

6. *Problem and its solution*

Seen against the background of the above-mentioned prior art, the problem with which the alleged invention is concerned is to provide a low viscosity, easily handled solvent free product, which is readily capable of being used for impregnating bodies such as bundles of glass fibre, and can cure to a strong hard solid with a minimum of shrinkage. Although component (A) is dissolved in component (B), component (B) is a co-reacting monomer, as contrasted with an organic solvent. Such an organic solvent is normally evolved from the composition upon curing, with consequent problems with respect to dimensional stability. The results set out in Tables 1 and 2 indicate that following the teaching of the alleged invention, products are capable of being obtained which have good storage stability, minimal shrinkage upon curing, and have considerable strength and elasticity. Accordingly the Board is satisfied that the alleged invention affords a credible solution to the above stated problem.

7. *Inventiveness*

7.1 The issue of inventiveness turns on whether a skilled person, having as his starting point the disclosure of D1, and confronted with the above defined problem, would have found in that document, or in any other of the cited prior art, a sufficient pointer in the direction of the alleged invention. The Board considers that, insofar as D1 teaches either the use of solid uncured mouldable compositions, as illustrated in Examples 1 and 2, or liquid compositions which are attainable only by the employment of a conventional solvent having later to be removed, as in Examples 3, 4 and 5, it is unlike the alleged invention, which involves a copolymerisation step in which component (A), after being initially

dissolved in component (B), is required to copolymerise with (B). (In addition, the cyanate esters which are essential to D1 are absent from the compositions according to the invention as defined in the main claim as now amended.) The Board is therefore satisfied that the teaching of D1 is so unlike the proposal in accordance with the alleged invention that the skilled worker would not have found in D1 any teaching in the direction of the alleged invention.

7.2 Equally, the Board finds that the teachings of FR-A-2 201 313 (D2) and FR-A-2 355 047 (D3) have little resemblance to the invention. D2 relates to a composition comprising (a) a prepolymer of a bisimide having a certain formula, which may include maleic anhydride groups in its molecule, which reacts with (b) an epoxy resin, and (c) an allyl monomer (page 1, lines 20 to 32). There is no suggestion of the formation of the bismaleimide-polyamine pre-reaction product dissolved in a monomer containing both an epoxy group and a vinyl group, which are essential features of the invention, and the Board is therefore satisfied that it does not provide any pointer in its direction.

7.3 D3 is also directed to a thermosetting composition. It involves four components, (a) a polyimide, (b) an alkenylphenol and/or an alkenylphenol ether, (c) an allyl group-containing epoxy compound, and optionally (d) an epoxy curing agent (page 17, Claim 1). Again, the Board regards this combination as being very unlike that of the invention, and hence sees in this disclosure no pointer towards the combination which is essential to the invention as now defined.

7.4 Accordingly, the Board is satisfied that the invention is not obvious in the light of this prior art.

8. *Conclusion*

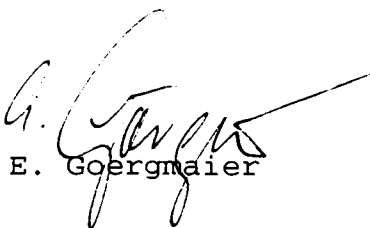
The subject-matter of Claim 1 of the patent in issue is novel for the purposes of Article 54 EPC, and involves an inventive step as required by Article 56 EPC and is therefore patentable. The same applies to the subject-matter of the dependent Claims 2 to 5, since they fall wholly within the scope of Claim 1.

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 the order that a patent be granted on the basis of Claims 1 to 5 and the amended description referred to in paragraph V above.

The Registrar:



E. Goergmaier

The Chairman:



F. Antony