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Aktenzeichen / Case Number / N<sup>o</sup> du recours : T 529/88 - 3.3.1

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Bezeichnung der Erfindung: Hardenable compositions, process to make a shaped  
Title of invention: article therefrom and dental appliance comprising  
Titre de l'invention : it.

Klassifikation / Classification / Classement : C08F 265/06

**ENTSCHEIDUNG / DECISION**  
vom / of / du 15 February 1990

Anmelder / Applicant / Demandeur :

Patentinhaber / Proprietor of the patent /  
Titulaire du brevet : Dentsply International Inc.

Einsprechender / Opponent / Opposant : Etablissement Dentaire Ivoclar

Stichwort / Headword / Référence : Dental appliance/DENTSPLY

EPÜ / EPC / CBE Articles 56 and 100(b)

Schlagwort / Keyword / Mot clé : "Inventive step (confirmed)"  
"Sufficiency of disclosure (confirmed)"

**Leitsatz / Headnote / Sommaire**

Europäisches  
Patentamt  
Beschwerdekammern

European Patent  
Office  
Boards of Appeal

Office européen  
des brevets  
Chambres de recours



Case Number : T 529 /88 - 3.3.1

**D E C I S I O N**  
of the Technical Board of Appeal 3.3.1  
of 15 February 1990

**Appellant :** Establissement Dentaire Ivoclar  
(Opponent) FL-9494 Schaan  
Liechtenstein

**Representative :** Uexküll & Stolberg  
Beselerstrasse 4  
D-2000 Hamburg 52

**Respondent :** Dentsply International Inc.  
(Proprietor of the patent) 570 West College Avenue  
York, Pennsylvania 17405 (US)

**Representative :** Dr. Günter Wächtershäuser  
Tal 29  
D-8000 München 2

**Decision under appeal :** Interlocutory decision of the Opposition Division of  
the European Patent Office dated 10 October 1988  
concerning maintenance of European Patent  
No. 0 014 515 in amended form.

**Composition of the Board :**

**Chairman :** K.J.A. Jahn  
**Members :** R.W. Andrews  
C.V. Payraudeau

## Summary of Facts and Submissions

I. The mention of the grant of European patent No. 0 014 515 in respect of European patent application No. 80 300 030.6, filed on 4 January 1980 and claiming priority of 1 February 1979 from a prior application filed in the United States of America, was announced on 14 March 1984 (cf. Bulletin 84/11).

II. A notice of opposition was filed on 12 December 1984 in which the revocation of the patent was requested on the grounds that its subject-matter lacked novelty and did not involve an inventive step. The opposition was supported, *inter alia* by the following documents:

(1) Polymer Blends and Composites, J.A. Manson and L.H. Sperling, pages 53, 54 and 237 to 256, 1977 and

(2) US-A-3 534 122.

During the proceedings, the Opposition Division referred to the following document:

(4) GB-A-569 975.

III. By an interlocutory decision dated 10 October 1988, the Opposition Division maintained the patent in amended form on the basis of Claims 1 to 5 filed on 20 August 1986, which were amended during the oral proceedings held on 10 July 1987 to correct obvious clerical errors in Claims 1 and 3. The independent Claims 1 and 5 of this amended statement of claim read as follows:

"1. A process for producing a hard, water insensitive shaped dental appliance having a high grind resistance by

- (1) forming a moldable composition by the steps of
  - (1a) blending a composition comprising
    - (A) 20 to 66% of liquid monofunctional polymerizable monomer,
    - (B) 7 to 27% of di- or polyfunctional cross-linking agent, which is reactive with said monomer,
    - (C) 10 to 70% of cross-linked polymer in the form of discrete particles having average diameters ranging from 0.001  $\mu\text{m}$  to 500  $\mu\text{m}$ , whereby at least 50% by weight of said particles have diameters less than 100  $\mu\text{m}$  and being swellable by said monomer but insoluble therein, said cross-linked polymer having been obtained by polymerizing a mixture of monofunctional monomer and di- or polyfunctional cross-linking agent, whereby the amount of the cross-linking agent is chosen such that
      - (a) it is sufficient to prevent the particulate cross-linked polymer from losing its particulate discreteness upon exposure to the monomer component and
      - (b) it provides a cross-linked polymer with the capacity to swell with from 10 to 500% of its own weight of monomer component and
      - (c) it is within the range of 0.01% to 30% by weight of the cross-linked polymer and

- (D) 0 to 50% of an uncross-linked polymer capable of dissolving in component (A), said percentages being based on the total weight of A, B, C and D, whereby
- (E) optionally one or more members selected from the group consisting of free radical initiators, photochemical initiators, activators, pigments, fillers, adhesion modifiers and radiopaquing agents is included; and
- (1b) aging said blend for a period of time sufficient to fully swell said cross-linked polymer particles with the mixture of said monomer and cross-linking agent dissolved therein, whereby optionally in a preswell stage cross-linked polymer particles are caused to swell with a mixture of polymerizable monomer and cross-linking agent at a time preceding the final mixing of the ultimate composition,
- (2) thereafter shaping the obtained moldable composition and
- (3) exposing said composition to heat or electromagnetic radiation to harden it and provide a shaped article.
5. A dental appliance, obtainable by the process of one of Claims 1 to 4".

The Opposition Division decided that the subject-matter of the amended claims was novel and involved an inventive step. In the light of the closest prior art as represented by document (4), the Opposition Division considered that the objective technical problem to be solved by the disputed patent was to improve the grind and solvent resistance of a dental appliance without impairing its

bonding ability. In the Opposition Division's view the essential differences between the present process and that disclosed in document (4) are responsible for the advantageous properties of the dental appliances resulting from the claimed process. The passages cited from document (1) are not concerned with the production of dental appliances and no direct conclusions could be drawn with respect to the influence of a completely interpenetrating structure on grind resistance of the final product. The Opposition Division also considered that the Opponent's belated allegation of insufficiency was unfounded.

- IV. An appeal was lodged against this decision on 22 October 1988 with payment of the prescribed fee. A Statement of Grounds of Appeal was filed on 14 February 1989. In their statement and during the course of the oral proceedings held on 15 February 1990, the Appellants maintained that the disclosure of the disputed patent was insufficient. In this connection, they alleged that polymer particles having average diameters of  $0.001 \mu\text{m}$  (1 nanometer) do not exist and that cross-linked polymers containing 0.01% or 30% by weight of a cross-linking agent are soluble or unswellable respectively. Furthermore, the Patentee's Test Report A, filed on 20 August 1986, shows that Example V of document (4) does not give a mouldable material after aging since the amount of monomer is insufficient for the weight of cross-linked solid polymer used. However, the only difference between this prior process and the present one lies in the amount of cross-linking agent present in the monomer mixture and this clearly cannot have any influence on the nature and duration of the swelling of the polymer.

The Appellants contended that, in the absence of any surprising effect, an inventive step could not be

recognised for the application of the interpenetrating polymer network (IPN) technology known from document (1) to the dental field. In the Appellants' opinion, the use of IPN technology for the manufacture of dental appliance is disclosed in documents (2) and (4).

According to the Appellants, it was clear from the originally filed patent application that the requirement that the amount of cross-linking agent in the monomer mixture should be at least 7% by weight was not critical. It was only necessary that the total amount of cross-linking agent should be balanced in an appropriate manner between the monomer mixture and cross-linked polymer to provide a polymeric material with the desired abrasion resistance without undue brittleness.

The Appellants also considered that the reference in document (1) to allowing ample time for diffusion so that the swelling is uniform during the preparation of IPN's clearly teaches that full swelling is a basic condition in IPN technology.

- V. In their observations in reply and during the oral proceedings, the Respondents argued that the patent discloses the invention in a manner sufficiently clear and complete for it to be carried out by the skilled person. Thus, compositions for use in the claimed process must not only satisfy the numerical values set out in the claims but must also be mouldable after aging. Similarly, the amount of cross-linking agent in the cross-linked polymer must not only fall within the range specified in C(c) of Claim 1 but also satisfy the conditions laid down in C(a) and (b).

The Respondents argued that document (1) was concerned with the development of high-impact resistance materials similar to high-impact polystyrene and, since impact resistance is

not important for dental appliances, this document would not be of any assistance to the skilled person faced with the problem of improving plastic teeth in such a way that their abrasion and solvent resistance approach that of porcelain ones.

According to the Respondents, the present invention lies in the realisation that in order to improve the grind and solvent resistance with respect to conventional plastic teeth it is essential that the monomer mixture contains a relatively large amount of cross-linking agent and that the particles of the cross-linked polymer have a small average diameter and are swellable in the monomer mixture. Furthermore, before polymerisation of the composition it should be aged to allow for the full swelling of the cross-linked polymer particles.

- VI. The Appellants requested that the decision under appeal be set aside and the patent revoked. The Respondents requested that the appeal be dismissed.
- VII. At the conclusion of the oral proceedings, the Board's decision to dismiss the appeal was announced.

#### **Reasons for the Decision**

1. The appeal complies with Articles 106 to 108 and Rule 64 EPC and is, therefore, admissible.
2. There are no formal objections to the current claims in accordance with Article 123 EPC since they are supported by the original disclosure and do not extend the protection conferred.

- 2.1 Thus, present Claim 1 is based on originally filed Claims 20, 21, 25, 29 and 36 in combination with page 7, line 22 to page 8, line 8, page 9, line 15, page 10, lines 15 to 17, page 12, lines 3 to 6, page 13, lines 24 to 27, page 17, line 28 to page 18, line 10 and page 18, lines 14 to 16 of the published patent application (cf. also granted Claims 18, 19, 23, 27 and 32 and page 4, lines 19 to 25 and 48, page 4, line 25 to page 5, line 1, page 5, lines 30 and 31, page 5, line 64 to page 6, line 1 and page 7, lines 10 to 17 and 20 to 22 of the printed patent specification).
- 2.2 Claim 2 finds its support on page 18, lines 21 to 25 of the published patent application (cf. also page 7, lines 25 to 27 of the printed patent specification).
- 2.3 Claim 3 represents a combination of originally filed Claims 20 and 22 to 25 (cf. granted Claims 18 and 20 to 23).
- 2.4 Claim 4 finds its basis on page 27, lines 28 and 29 of the published patent application (cf. page 9, lines 53 and 54 of the patent specification).
- 2.5 Claim 5 corresponds essentially to the originally filed Claim 40 (cf. granted Claim 36).
3. In the Board's judgement, the disputed patent discloses the invention in a manner sufficiently clear and complete for it to be carried out by the skilled person.
  - 3.1 In the Board's view, the Appellants' allegation with respect to the non-existence of polymer particles having an average diameter of 0.001  $\mu\text{m}$  has neither been proven nor disproven. Under these circumstances and, since a definition of the cross-linked polymer particles as having

average diameters of up to 500  $\mu\text{m}$  whereby at least 50% by weight of said particles have diameters less than 100  $\mu\text{m}$ , would not have given rise to an objection with regard to insufficiency, the Board finds there is no justification for revoking the patent in suit solely on this ground.

- 3.2 As to the additional invoked reasons for the alleged insufficiency, the Appellants have disregarded the fact that, in accordance with Claim 1, the amounts of cross-linking agents must be selected having regard to the criteria (a), (b) and (c), which, in the Board's judgement, are to be considered as limiting functional features.

With respect to the amount of cross-linking agent in the cross-linked polymer, the Appellants have provided no evidence to support their allegation that a cross-linked polymer containing 0.01% by weight of cross-linking agent would be soluble. However, independent of the amount of cross-linking agent present, a soluble cross-linked polymer would not satisfy requirement (C)(a) of Claim 1 and would not be covered by it.

With respect to the upper limit for the amount of cross-linking agent, the Appellants have relied on the experimental evidence filed by the Respondents. However, this experiment was carried out with only one cross-linking agent and the possibility that a cross-linked polymer fulfilling the requirement of (C)(b) of Claim 1 containing 30% by weight of a less reactive, high molecular weight cross-linking agent cannot be excluded.

- 3.3 Since Example V of document (4) falls outside the scope of the present claims, no conclusions regarding insufficiency of the disclosure of the patent in suit can be drawn from the repetition of this Example according to the Respondents' Test Report A.

4. The present invention relates to a process for producing a hard, water-insensitive shaped dental appliance by moulding, shaping and hardening a composition comprising a liquid monofunctional monomer, a di- or polyfunctional cross-linking agent which is reactive with said monomer and a cross-linked polymer in the form of discrete particles. Document (4), which may be considered to represent the closest prior art, discloses a similar process.

However, it was considered that the abrasion and solvent resistance of the dental appliances obtained by means of this prior art process were not satisfactory. In this respect, the Board accepts the Respondent's statement made during oral proceedings that a dental appliance manufacture in accordance with Example V of document (4) would have a grind resistance similar to conventional acrylic teeth, i.e. in the range 90 to 140 g/s as measured by the test referred to on page 11, lines 6 to 8 of the disputed patent.

- 4.1 In the light of the closest prior art, the technical problem underlying the patent in suit may be seen in providing a process for the manufacture of dental appliances, the abrasion and solvent resistance of which are better than those of the dental appliances manufactured by this known process.

According to the disputed patent, this technical problem is essentially solved by blending, in specified amounts, a liquid monofunctional polymerisable monomer, a di- or polyfunctional cross-linking agent, which is reactive with the monomer and a cross-linked polymer in the form of small discrete particles, aging this blend to allow the cross-linked polymer particles to fully swell with the

mixture of monomer and cross-linking agent, shaping and polymerising the aged blend.

- 4.2 In view of the results of Tests Reports B and E filed on 20 August 1986 and the statements on page 11, lines 9 to 20 of the disputed patent, the Board is satisfied that the technical problem underlying the patent in suit is plausibly solved.
5. After examination of the cited prior art, the Board has reached the conclusion that the subject-matter of the current claims is novel. Since novelty is no longer in dispute, it is not necessary to consider this matter in detail.
6. It still remains to be examined whether the requirement of inventive step is met by the claimed subject-matter.
- 6.1 Document (4) discloses three processes for the production of dental appliances. The process according to Claim 1, which is illustrated in Examples I to IV, comprises polymerising a mixture of polymeric methyl methacrylate and monomeric methyl methacrylate containing a minor proportion of methallyl methacrylate. In a second embodiment, a mixture of a cross-linked polymer formed by polymerising methyl methacrylate with a minor proportion of methallyl methacrylate and monomeric methyl methacrylate containing a minor proportion of methallyl methacrylate is polymerised (cf. Claim 2 and Example 5). The third process comprises polymerising a mixture of monomeric methyl methacrylate with a cross-linked polymer formed by polymerising methyl methacrylate with a minor proportion of methallyl methacrylate (cf. Claim 3 and Example VI).

It is true that the process according to Claim 2 resembles that of the patent in suit insofar as the components A, B

and C are concerned. However, there is no disclosure that such mixtures should be aged for a period of time sufficient to allow the performed cross-linked polymer to fully swell before shaping and final polymerisation. Such a procedure is absolutely mandatory for the formation of an IPN structure which was discovered decades after the issue of document (4).

This is in line with the Respondents' Test Report A, since the duplication of Example V of this document revealed that the the doughy consistency, which is a prerequisite for moulding, only exists immediately after mixing and disappears if the mixture is allowed to stand.

Moreover, there is no teaching in this document which would provide the skilled person with any indication that the three processes disclosed therein do not give equivalent results with respect to abrasion and solvent resistance and, therefore, his attention would not be drawn to any one of the processes in particular in his search for a solution to the problem underlying the disputed patent.

Above all, from the teaching of this document, the skilled person could not deduce that for the specified compositions a correlation exists between the grind resistance of the dental appliances and the degree of swelling or that it would be possible to establish a cross-linking density of the polymer, which upon full swelling produces increased grind resistance.

- 6.2 Document (2) discloses a process for the polymerisation of dental doughs consisting of liquid monomeric acrylate and methacrylate esters of monohydric and polyhydric alcohols containing solid polymers as thickening agents to yield bubble-free, hard, solid products of high clarity and high transparency which are resistant to discolouration by

ultraviolet light (cf. Claim 1 and Examples 1 to 4). The solid polymers used as thickening agents are selected from poly(methyl methacrylate), methyl methacrylate copolymerised with from 2 to 10% of allyl methacrylate, or with from 3 to 10% of ethyl acrylate, or with from 5 to 30% of ethylene glycol dimethacrylate, or with 5 to 95% of triethylene glycol dimethacrylate and poly(tetraethylene glycol dimethacrylate (cf. Claim 1).

Thus, although there are no specific Examples disclosing the preparation of IPN's, nevertheless the polymerisation of certain combinations of the reactants cited in Claim 1 might lead to the formation of IPN networks.

However, the solid polymers listed in Claim 1 include uncross-linked ones which would be capable of dissolving in the liquid monomer, and highly cross-linked ones which are not only insoluble in the liquid monomer but also unswellable therein. Additionally, the essential feature of the invention of this earlier patent is the development of a unique catalyst system for the preparation of high clarity, bubble free acrylic sheeting for architectural and aircraft glazing which also resists discolouration by ultraviolet light (cf. column 2, lines 50 to 62).

Therefore, from the teaching of this document the skilled person would not appreciate the important role the history of the compositions specified in Claim 1 of the disputed patent prior to polymerisation plays in determining the abrasion resistances of the final products. Since such an appreciation is essential to the solution of the technical problem underlying the disputed patent, the disclosure of this document, even combined with that of document (1), would not provide the skilled person with any indication pointing in the direction of the proposed solution.

6.3 Document (1) discusses the synthesis, morphology and mechanical behaviour of IPN's. According to this document, IPN's are obtained by preparing a cross-linked polymer network, swelling in a second monomer together with activator and cross-linking agent, and polymerising in situ (cf. page 54, lines 2 to 4). According to the more detailed information in first six lines of the third paragraph on page 238, the second polymer network is synthesised by swelling in a controlled amount of monomer together with activator, allowing ample time for diffusion so that the swelling is uniform and photopolymerising or thermally initiating with peroxide species. Thus, this document emphasises the uniformity of the swelling rather than its completeness.

With respect to the mechanical properties of IPN's this document suggests that IPN's are another example of the simple requirement of needing only a hard or plastic phase sufficiently finely divided in an elastomer to yield significant reinforcement (cf. lines 6 to 9 of the complete paragraph on page 255). This may be reflected in an increase in both ultimate elongation and stress to break (cf. Figure 8.22 on page 254) or a very high Charpy impact resistance (first two lines of the paragraph bridging pages 255 and 256). However, this document is wholly silent with respect to the abrasion resistance of IPN's and in the absence of any definite correlation between the above-mentioned mechanical properties and abrasion resistance, the teaching of this document either alone, or combined with that of document (2) or (4), would not suggest that the solution to the problem underlying the disputed patent lies in blending the components specified in Claim 1 and allowing the blended mixture to age to ensure that the particles of the cross-linked polymer are completely swollen with the monomer mixture.

7. In the Board's judgement, the proposed solution to the technical problem of improving the abrasion and solvent resistance of the dental appliances disclosed in document (4) is not obvious in the light of the cited prior art. Therefore, the subject-matter of Claim 1 involves an inventive step.
- 7.1 Claims 2 to 4, which claim preferred embodiments of the process according to Claim 1, are also allowable.
- 7.2 Claim 5, which relates to dental appliances obtainable by the process of any one of Claims 1 to 4, is also acceptable in view of the unexpected improvement in the abrasion and solvent resistance of the said dental appliances.

**Order**

**For these reasons, it is decided that:**

The appeal is dismissed.

**The Registrar:**



M. Beer

**The Chairman:**



K. Jahn