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**D E C I S I O N**  
of 6 July 2000

**Case Number:** T 0870/97 - 3.3.2

**Application Number:** 91202296.9

**Publication Number:** 0475528

**IPC:** A61K 6/04

**Language of the proceedings:** EN

**Title of invention:**

A dental procelain, a method of producing a dental restoration,  
a dental alloy

**Patentee:**

Elephant Edelmetaal B.V.

**Opponent:**

Heraeus Kulzer GmbH  
Vita Zahnfabrik H. Rauter GmbH & Co.  
Ivoclar AG

**Headword:**

Dental Procelain/ELEPHANT EDELMETAAL B.V.

**Relevant legal provisions:**

EPC Art. 123, 54, 56

**Keyword:**

"Main request - not allowable under Article 123(3) EPC"  
"First auxiliary request - obvious alternative porcelain"  
"Second auxiliary request - novel and inventive - improved  
stability of the porcelain"

**Decisions cited:**

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**Catchword:**

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Case Number: T 0870/97 - 3.3.2

**D E C I S I O N**  
of the Technical Board of Appeal 3.3.2  
of 6 July 2000

**Appellant:**  
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Decision under appeal:

Decision of the Opposition Division of the  
European Patent Office posted 2 June 1997  
revoking European patent No. 0 475 528 pursuant  
to Article 102(1) EPC.

Composition of the Board:

Chairman: P. A. M. Lançon  
Members: U. Oswald  
C. Rennie-Smith

## Summary of Facts and Submissions

- I. European patent No. 475 528, based on application No. 91 202 296.9, was granted with a set of 17 claims.

The independent claims as granted read as follows:

"1. A process of producing a dental restoration such as a dental crown, inlay, bridge etc. comprising a substructure from a dental alloy which is at least partially coated with one or several layers of a fired-on dental porcelain, which process comprises firing a dental porcelain having a thermal expansion coefficient, measured at a temperature of from 20 to 500°C, above  $14.5 \mu\text{m}/\text{m}/^\circ\text{C}$  and a firing temperature below 950°C, onto a substructure from a dental alloy having a thermal expansion coefficient, measured at a temperature of from 20 to 500°C, which is higher than that of the dental porcelain by  $0.5\text{-}1.5 \mu\text{m}/\text{m}/^\circ\text{C}$  and having a solidus temperature which is higher by at least 50°C than the temperature at which the dental porcelain is fired on.

10. A dental porcelain for use in the process according to any one of the claims 1-9, having a thermal expansion coefficient, measured at a temperature of from 20 to 500°C, above  $14.5 \mu\text{m}/\text{m}/^\circ\text{C}$  and a firing temperature below 950°C.

14. A dental gold-silver alloy for use in the process of any of the claims 1-9, which is essentially copper free, has a thermal expansion coefficient, measured at a temperature of from 20 to 500°C, of at least  $15 \mu\text{m}/\text{m}/^\circ\text{C}$ , a solidus temperature of at least 1000°C and a zinc content of 0.5-2 wt.%"

II. Three oppositions were filed by the Respondents (Opponents), herein referred to individually as Respondent 01, Respondent 02 and Respondent 03, all alleging lack of both novelty and inventive step under Article 100(a) EPC.

Of the numerous documents cited during the proceedings the following remain relevant to the present decision:

(2) DE-B-1 441 336

(4) EP-A-0 155 564

(11) Dr. H. Claus, Entwicklung der Metallkeramik, Sonderdruck aus "Das Deutsche Zahnärzteblatt", 89. Jrg. Nr. 3/1980, pages 36-39,

(12) Dr. H. Claus, Werkstoffkundliche Grundlagen der Dentalkeramik, Sonderdruck aus "dental-labor", Heft 10/1980, pages 1743 to 1750, Verlag Neuer Merkur GmbH, 8000 München 46

(13) J.R. Mackert Jr., "Effects of Thermally Induced Changes on Porcelain-Metal Compatibility", Perspectives in Dental Ceramics, Proceedings of the Fourth International Symposium on Ceramics, Quintessence Publishing Co., Inc. 1988

(14) US-A-3 052 982

(17) D. Binns, "Die chemischen und physikalischen Eigenschaften des Dentalporzellans", Dental-Keramik, Quintessenz Verlags-GmbH 1984, pages 41 to 81.

III. The Opposition Division decision of 24 April 1997, posted on 2 June 1997, revoked the Patent under Article 102(1) EPC, finding that neither the claims of the main request nor those of the auxiliary requests I to III met the requirements of the EPC.

More particularly it was held that the porcelain of claim 10 as granted (main request) and claim 9 of auxiliary request II were not novel with regard to example 6 of document (2).

Concerning auxiliary requests I and III, the Opposition Division decided that the amendment to claim 1 in these requests was not caused by grounds of opposition and consequently these requests contravened Rule 57(a) EPC.

IV. The Appellant (Proprietor) lodged an appeal against this decision.

V. In response to a communication of the Board, annexed to the summons to attend oral proceedings, the Appellant filed on 6 June 2000 a main request and auxiliary requests I to V.

VI. Oral proceedings took place on 6 July 2000 during which the Appellant filed a new auxiliary request II.

The claims of the requests can be summarized as follows:

The main request corresponds to claims 1-13 as granted and an additional claim 14 which reads as follows:

"14. Dental restoration such as a dental crown, inlay, bridge ect. comprising a substructure form a dental alloy which is at least partially coated with one or several layers of a fired-on dental porcelain, wherein the dental porcelain has a thermal expansion

coefficient, measured at a temperature of from 20 to 500°C, above 14.5  $\mu\text{m}/\text{m}/^\circ\text{C}$  and a firing temperature below 950°C, and wherein the dental alloy has a thermal expansion coefficient, measured at a temperature of from 20 to 500°C, which is higher than that of the dental porcelain by 0.5-1.5  $\mu\text{m}/\text{m}/^\circ\text{C}$  and has a solidus temperature which is higher by at least 50°C than the firing temperature of the dental porcelain."

The auxiliary request I corresponds to claims 1-13 as granted

The two independent claims of auxiliary request II as amended during oral proceedings read as follows:

"1. A process of producing a dental restoration such as a dental crown, inlay, bridge ect. comprising a substructure from a dental alloy which is at least partially coated with one or several layers of a fired-on dental porcelain, which process comprises firing a dental porcelain having a thermal expansion coefficient, measured at a temperature of from 20 to 500°C, above 14.5  $\mu\text{m}/\text{m}/^\circ\text{C}$  and a firing temperature below 950°C, wherein said dental porcelain is prepared from three different glass compositions consisting of

- (a) 50-80 wt.% of at least one frit having a high content of leucite crystals;
- (b) 5-45 wt.% of at least one glass frit related to the matrix glassy phase of said at least one frit (a); and
- (c) 5-15 wt.% of at least one low melting glass frit;

onto a substructure from a dental alloy having a thermal expansion coefficient, measured at a temperature of from 20 to 500°C, which is higher than that of the dental porcelain by 0.5-1.5  $\mu\text{m}/\text{m}/^\circ\text{C}$  and having a solidus temperature which is higher by at least 50°C than the temperature at which the dental porcelain is fired on.

8. A dental porcelain for use in the process according to any one of the claims 1-7, having a thermal expansion coefficient, measured at a temperature of from 20 to 500°C, above 14.5  $\mu\text{m}/\text{m}/^\circ\text{C}$  and a firing temperature below 950°C, which dental porcelain is prepared from three different glass compositions consisting of

- (a) 50-80 wt.% of at least one frit having a high content of leucite crystals;
- (b) 5-45 wt.% of at least one glass frit related to the matrix glassy phase of said at least one frit (a); and
- (c) 5-15 wt.% of at least one low melting glass frit."

Auxiliary requests III to V are based on claims as granted or combinations thereof.

VII. The Appellant argued that document (2), in particular example 6, did not disclose a dental porcelain having a high TEC (thermal expansion coefficient) of more than 14.5  $\mu\text{m}/\text{m}/^\circ\text{C}$  coupled with a low firing temperature of less than 950°C. In fact the composition given in example 6 had a TEC of 13  $\mu\text{m}/\text{m}/^\circ\text{C}$  and a melting point of about 900°C.

Besides the importance of a high TEC and low firing temperature, another characteristic of the claimed porcelain was the stability of its TEC within a broad temperature range, a characteristic obtained by making it from at least three different frits resulting in a physical structure not known from the prior art.

In support of its arguments the Appellant filed an expert's report showing that the Respondent 03's expert did not measure the TEC in the temperature range from 20 to 500°C, as the patent required, but in a temperature range from 100 to 500°C which would give higher TEC values.



The Appellant claimed its own expert's report provided further evidence that using three different glass compositions produced a structural difference in the content and size of leucite crystals when compared with known porcelains. Since that structural difference led to improved stability, the porcelain of the patent clearly showed an inventive step.

The same report also contained technical information which, like the Respondent 03's expert's report, showed that the melting temperatures of components 6 and 7 used in the preparation of the porcelain of example 6 of document (2) were erroneous.

VIII. The Respondents argued that component 6 described in document (2) (col. 10, 1.58 to col. 11, 1.2) disclosed physical properties of the claimed porcelain and was therefore prejudicial to its novelty.

The claimed porcelain also lacked novelty in the light of the disclosure of document (4) describing porcelains having a TEC between 8 and 20  $\mu\text{m}/\text{m}/^\circ\text{C}$  and a firing temperature between 815 and 1315 $^\circ\text{C}$ .

Additionally, Respondent 03 claimed its expert's report established that it was possible, by strictly following the teaching of document (2), to modify the percentages of the different components used in example 6 so as to prepare a porcelain with a TEC and a firing temperature corresponding to those of the porcelain claimed in the patent.

This report also stated that the melting temperatures of components 6 and 7 used in the preparation of the porcelain of example 6 of document (2) were erroneous.

As regards inventive step the Respondents argued *inter alia* that in view of the closest prior art represented by document (2), either taken alone or in combination with document (4) or one of the other relevant documents, the claimed invention should be regarded as obvious.

- IX. The Appellant requested that the decision under appeal be set aside and that the patent be maintained on the basis of the main request, alternatively one of auxiliary requests I-V (all filed on 6 June 2000 save the amended auxiliary request II filed during the oral proceedings).

The Respondents requested that the appeal be dismissed.

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

1. The appeal is admissible.
2. *Main Request*

It is generally accepted that a claim to a product confers a monopoly on that product independently of the process whereby it is made. Claim 14 of the main request claims a product, namely a dental restoration *per se*. However, the patent as granted contains only a process for preparing dental restorations. By virtue of Article 64(2) EPC, protection for dental restorations can only be allowed when they are directly obtained by that process and cannot extend to restorations otherwise obtained.

The Board cannot agree with the Appellant's view that, since claims 10 and 14 as granted conferred protection respectively on a porcelain and an alloy as "parts" of the dental restorations, a claim directed to the combination of those "parts" does not extend the scope of protection.

The dental restorations as claimed cannot be equated with a dental porcelain as claimed in granted claim 10, nor with a dental alloy according to claim 14 as granted. Accordingly as now worded, claim 14 does not correspond to any of the granted claims nor does it amount to a limitation of either of the granted claims referred to.

Furthermore, dental restorations require a good metal-porcelain bonding which is achieved by a thin oxide layer on the metal alloy (see the patent specification page 5, lines 25/26 and 51). Therefore, a dental restoration has to be considered as a product of a different nature than the mere combination of the alloy and porcelain from which it is made.

Consequently, since claim 14 of the main request seeks protection for dental restorations not protected by the patent as granted, the request is not allowable under Article 123(3) EPC and must be refused.

3. *First auxiliary request*

3.1 *Amendments*

The set of claims of the first auxiliary request correspond to claims 1-13 as granted and the Respondents raised no objection under Article 100(c) EPC.

### 3.2 Novelty

The first auxiliary request comprises two independent claims, namely claim 10 which relates to a dental porcelain and claim 1 which relates to a process for producing a dental restoration in which a dental porcelain as defined in claim 10 is fired on a dental alloy.

Besides the functional feature "for use in the process according to any one of the claims 1-9", the claimed porcelain is characterised by two physical properties namely, a thermal expansion coefficient (TEC), measured at a temperature of from 20 to 500°C, above 14.5  $\mu\text{m}/\text{m}/^\circ\text{C}$  and a firing temperature below 950°C.

In the decision under appeal it was concluded that the porcelain of claim 10 was not novel with regard to document (2).

#### 3.2.1 Document (2) indeed relates to dental restoration procedures whereby porcelains are fired onto a dental alloy substructure.

The porcelains of document (2) should in general have a TEC between 9 and 17  $\mu\text{m}/\text{m}/^\circ\text{C}$  from room temperature to the temperature at which they become plastic ("plastischen Zustandes Temperatur") and a firing temperature above 982°C for the high melting porcelains or between 900 and 980°C for the low melting porcelains (see column 1, lines 1 to 8, lines 32 to 43 and claim 1, column 2, lines 56 to 60 and column 3, lines 24 to 26 and 39 to 41).

Example 2 relates to a porcelain with a TEC higher than 14.5  $\mu\text{m}/\text{m}/^\circ\text{C}$  and a firing temperature of 1315°C.

Examples 4 and 5 of document (2) concern porcelains with a TEC of  $14 \mu\text{m}/\text{m}/^\circ\text{C}$  when measured from room temperature to the temperature at which they become plastic and a firing temperature under  $954^\circ\text{C}$ .

The ranges disclosed in document (2) can be seen to overlap with those of the present claims. However, the Board notes that document (2) does not disclose the combination of an actual pair of values of a TEC higher than  $14.5 \mu\text{m}/\text{m}/^\circ\text{C}$  and firing temperature below  $950^\circ\text{C}$  for a single product.

- 3.2.2 Since the experiments carried out by Respondent 03's expert did not in fact reproduce the examples of document (2) and since the experimental data in his report are based on measurements in the range from  $100^\circ\text{C}$  to  $500^\circ\text{C}$ , which will undisputedly give higher TEC values than measurements in the range from  $20^\circ\text{C}$  to  $500^\circ\text{C}$ , the Board cannot accept those experiments as conclusive for the issue of novelty.

The Board is well aware that component 6, which is used in the preparation of the low fusing porcelains of example 6 of document (2), has a TEC of  $17 \mu\text{m}/\text{m}/^\circ\text{C}$  and a fusing point of  $900^\circ\text{C}$  (see Document (2), column 10, lines 49 to column 11, line 2).

However, it was agreed by the parties' experts that the firing temperature of  $900^\circ\text{C}$  indicated for component 6 is a mistake and should in fact be much higher, namely  $980^\circ\text{C}$  or  $990^\circ\text{C}$ .

Accordingly, for the purposes of Article 54 EPC, the disclosure of document (2) regarding the specific aspect of the firing temperature of component 6 cannot be taken into account when comparing the patent with the prior art.

- 3.2.3 In the written proceedings the Respondents also argued that document (4), which discloses porcelains having a TEC between 8 and 20  $\mu\text{m}/\text{m}/^\circ\text{C}$  and a firing temperature between 815 and 1315 $^\circ\text{C}$ , undermines the novelty of the claimed porcelains.

As mentioned above in the case of document (2), the TEC and firing temperature ranges of document (4) can be seen to overlap with the parameter ranges of the patent in suit, but equally document (4) does not disclose the combination of an actual pair of values of a TEC higher than 14.5  $\mu\text{m}/\text{m}/^\circ\text{C}$  and firing temperature below 950 $^\circ\text{C}$  for a single product.

- 3.2.4 Since none of the other cited documents disclose the physical properties of the porcelain claimed in the first auxiliary request, the Board concludes that this porcelain is novel under Article 54 EPC.

It follows that the process for producing dental restorations using the claimed porcelain can also be regarded as fulfilling the requirements of Article 54 EPC.

### 3.3 Inventive step

- 3.3.1 It was undisputed by the parties that document (2) represents the closest prior art.

Having regard to the disclosure of this document (see paragraph 3.2.1 above), the Appellant submitted that the problem underlying the patent in suit was to provide a dental porcelain the improved physical stability of which would withstand several firing steps.

However, taking into account the parties' submissions and the description of the patent in suit (particularly page 6, lines 1 to 6 and lines 16 to 39), it is clear that the specific combination of parameters of a high TEC above  $14.5 \mu\text{m}/\text{m}/^\circ\text{C}$  and a firing temperature below  $950^\circ\text{C}$  do not of themselves provide the desired thermal expansion stability during repeated firing of the porcelain but that the desired effect can only be achieved when the porcelain is prepared by combining three different frits in the basic material.

Furthermore, it is indicated in the description that the patent's porcelain is suitable for firing on a hard yellow gold alloy (page 3, lines 23 to 26) and that it was a problem to obtain alloys which were both yellow in colour and suited to a porcelain covering (page 2, lines 43 to 57, page 3, lines 23 to 26). In this respect the Board notes that on appeal the Appellant did not continue to claim dental alloys per se.

Having regard to the TEC values and firing temperatures known, for example, from document (2) which come very close to the corresponding values of the porcelain of the patent, the Board considers that the prior art porcelains were also suitable for firing on yellow gold alloys.

In these circumstances, no improvement over the closest prior art can be discerned.

3.3.2 Accordingly, the problem can be seen as just the provision of alternative porcelains suitable for dental restorations.

The claimed solution to this problem is the combined TEC and firing temperature parameters of claim 10.

Having regard to the worked examples of the patent in suit, it appears credible to the Board that the problem has indeed been solved. This was not contested by the Respondents.

- 3.3.3 Apart from the fact that the teaching of document (2) is in no way limited to products having the TEC values and firing temperatures expressly mentioned in the worked examples, there is no evidence on file that the skilled person trying to prepare porcelains with parameters slightly modified from those given in document (2) would be confronted with any difficulties. Indeed example 6 of document (2) clearly suggests varying the ratios of the porcelain components in order to obtain other TECs and fusing ranges (see particularly column 11, lines 60 to 68).

Accordingly, the Board can only conclude that to a person skilled in the art the porcelain of claim 10 represents an obvious alternative to those already known from document (2) and that the subject-matter of claim 10 of auxiliary request I does not involve an inventive step as required by Article 56 EPC.

#### 4. *Second auxiliary request*

##### 4.1 Amendments

The Respondents did not raise any objection under Article 100(c) EPC and the claims of auxiliary request II are adequately supported by the patent in suit as granted. Thus, claim 1 is a combination of claims 1, 4 and 6 as granted; claims 2 and 3 correspond to claims 2 and 3 as granted; claim 4 is based on claim 5 as granted; claims 5 to 7 correspond to claims 7 to 9 as granted; claim 8 is a combination of claims 10, 11 and 13 as granted; and claim 9 is based on claim 12 as granted.



## 4.2 Novelty

Since the two independent claims 1 and 8 of auxiliary request II comprise the technical features of the corresponding independent claims of auxiliary request I which the Board has found (see 3.2 above) were not known from the available prior art, the subject-matter of auxiliary request II can be regarded novel.

## 4.3 Inventive step

4.3.1 It was not disputed by the parties that document (2) is also the closest prior art when considering auxiliary request II.

4.3.2 Unlike auxiliary request I, the Board can take into account the effect of stability of the porcelain (see point 3.3.1 above) in considering claim 8 of the second auxiliary request.

According to both the Appellant's submission and the description of the patent (page 6, lines 8 to 14), the dental porcelains known from the document (14) - the corresponding US document to document (2) - show expansion characteristics which vary with firing conditions. This is supported by a cross reference on page 5 of document (4) also indicating such disadvantages of prior art porcelains. The Respondents did not dispute this.

Therefore, starting from the disclosure in document (2) (see point 3.2.1 above), the problem to be solved can be seen as the provision of dental porcelain suitable to be fired on dental alloys and showing a thermal expansion stability after repeated firings.

The claimed solution is the combination of defined TEC and firing temperature parameters and defined proportions of three different glass compositions as the base material for the dental porcelain.

- 4.3.3 In the light of the description of the patent in suit, in particular table D at page 7 (not contested by the Respondents) which shows that the TEC of the porcelain of the invention remains almost constant after five firing steps, the Board is satisfied that the problem has indeed been solved.

Thus, it remains to consider whether the proposed solution would be obvious to the skilled person in the light of the available prior art.

- 4.4.4 Document (2) itself does not contain the slightest hint that the number of glass frits constituting the porcelain could have an influence on TEC values after a sequence of firing steps. In fact document (2), and corresponding document (14) cited in the description of the patent, teach that by varying the respective quantities of the two original glass frits the TEC values can be preselected but not independently from the firing temperature (see for example figure 8 in these documents).

- 4.4.5 In the same way document (4) indicates more generally that the TEC of a blend of glass ceramic frits with a glass matrix can be controlled, the series of frits containing different amounts of leucite being selected so as to govern the firing temperature, glass transition temperature, viscosity and translucency of the resulting system (see particularly the paragraph bridging pages 6 and 7). There is no teaching in document (4) that TEC values and firing temperatures of the porcelain can be preselected independently from each other.

4.4.6 Taking into account the disclosures of documents (4) and (2) as a whole, the skilled person could only conclude that it is impossible to reach a high TEC near to that of the dental alloy (e.g. above  $14.5 \mu\text{m}/\text{m}/^\circ\text{C}$ ) without simultaneously raising the fusion temperature of the porcelain. Thus example 1 of document (4) shows a dental porcelain having a fusion temperature of  $954^\circ\text{C}$ , which can be regarded as a low firing temperature preferred by those skilled in the art, but also having a low TEC of  $12.2 \mu\text{m}/\text{m}/^\circ\text{C}$  (see page 18, last paragraph).

4.4.7 The Respondents are right in their submissions that documents (2) and (4) contain a clear incentive to prepare dental porcelains from a base material comprising more than two glass compositions. However, the porcelain of the patent in suit uses defined proportions of three different glass compositions which allow with the specific result that **the state of equilibrium of the glass/porcelain phases** obtained during the production process is such that no mismatch of porcelain-to-metal expansion occurs in the final dental restoration product. This "phase equilibrium" argument put forward by the Appellant during the oral proceedings is supported by the description of the patent in suit on page 6, lines 16 to 44.

4.4.8 The Respondents' counter argument that documents (2) and (4) disclose porcelains having major chemical elements of the same analytical composition as the porcelains of the patent in suit and that accordingly after formation of the liquid phases during the preparation process of the porcelain no difference in parameters could in fact occur, is unconvincing. It is well-known in the art, and even supported by review articles such as documents (12), (13) and (17), that not only the overall analytical composition of the base

material but also the presence of different glass compositions, in the form of different glass frits, during the production process has a major influence on the ultimate microstructure and physical parameters of the resulting porcelain (see for example document (12), page 1748 figures 9 and 10 and similar comments in document (17), page 42 - text and phase diagram).

Document (17), at page 44, explicitly refers to the so-called "Weinstein" metal-ceramic dental restoration and thus incorporates the teaching of document (2), the basic "Weinstein" patent. Document (4), and the other review articles (11), (12) and (13), clearly explain the influence of a frit having a high content of leucite crystals on the TEC. However, these documents and articles are totally silent about stability of expansion over several firing steps and cannot therefore be seen as teaching at all towards the general principle underlying the solution offered by the present invention, namely the critical importance of the weight proportion of different porcelain frits in controlling the TEC over several firing steps, giving the possibility of maintaining the TEC value at a high level while at the same time having a low firing temperature.

- 4.4.9 Since the other documents cited during the proceedings are of less relevance, the Board can only conclude that both claim 8 and claim 1 of auxiliary request II, relating respectively to a dental porcelain and a process of producing a dental restoration whereby that porcelain is fired onto a dental alloy substructure, involve an inventive step as required by Article 56 EPC.

**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 claims as in the amended auxiliary request II submitted during the oral proceedings and a description to be adapted thereto.

The Registrar:

The Chairman:

M. Dainese

P. A. M. Lançon