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D E C I S I O N
of 27 June 2002

Case Number: T 0320/00 - 3.2.6

Application Number: 90309633.7

Publication Number: 0416852

IPC: B23K 26/00

Language of the proceedings: EN

Title of invention:

Multiple material system and assisted powder handling for selective beam sintering

Patentee:

BOARD OF REGENTS, THE UNIVERSITY OF TEXAS SYSTEM

Opponent:

EOS GmbH Electro Optical Systems

Headword:

-

Relevant legal provisions:

EPC Art. 52(1), 54, 56, 123(2), 102(3), 111(1)

Keyword:

"Admissibility of late filed documents - no"
"Disclosure in the application as filed - yes"
"Novelty and inventive step - yes"

Decisions cited:

G 0009/91

Catchword:

-



Case Number: T 0320/00 - 3.2.6

D E C I S I O N
of the Technical Board of Appeal 3.2.6
of 27 June 2002

Appellant: EOS GmbH Electro Optical Systems
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Decision under appeal: Decision of the Opposition Division of the
European Patent Office posted 2 February 2000
rejecting the opposition filed against European
patent No. 0 416 852 pursuant to Article 102(2)
EPC.

Composition of the Board:

Chairman: P. Alting van Geusau
Members: G. C. Kadner
M. B. Tardo-Dino

Summary of Facts and Submissions

- I. The mention of the grant of European patent No. 0 416 852 in respect of European patent application No. 90309633.7 claiming two US-priorities from 5 September 1989 and filed on 4 September 1990 was published on 16 July 1997.
- II. Notice of opposition was filed on 8 April 1998 by the Appellant, on the grounds of Article 100(a) and (c) EPC.
- III. By decision announced on 17 January 2000 and posted on 2 February 2000 the Opposition Division rejected the opposition against the European patent.

The Opposition Division arrived at the conclusion that the subject-matter of claim 1 together with its dependent claims met the provisions of Article 123(2) EPC as well as the requirements of novelty and inventive step according to Articles 54(1) and (56) EPC when compared with the prior art documents:

- D1: Römpf Chemie Lexikon, 9. Aufl., Georg Thieme Verlag 1989, pages 1223, 1224
- D2: US-A-4 247 508
- D3: WO-A-88/02677
- D4: Meyers Lexikon der Technik und der exakten Naturwissenschaften, Bibl. Institut AG Mannheim 1969, pages 491, 1186
- D5: Dubbel, Taschenbuch für den Maschinenbau, 17. Aufl., Springer Verlag 1990, pages E31-E33
- D6: E.M. Breinan et al.: New Developments in Laser Surface Melting Using Continuous realloyed Power Feed, Rapid Solidification Processing, Vol. II,

- Claitors Publishing 1980
- D7: JP-A-61-52373 with English translation
- D8: US-A-4 818 562
- D9: Biomat., Med. Dev., Art. Org., 13(1+2) 37-50
(1985): Post-Sintering Heat Treatments for Porous
Coated Ti-6Al-4V Alloy
- D10: DE-C-24 38 315
- D11: US-A-2 939 199
- D12: Römpps Chemie-Lexikon, Franckh'sche
Verlagsbuchhandlung Stuttgart, 9. Aufl. 1990,
page 1046
- D13: Oxford Advanced Learner's Dictionary of Current
English, 1984, page 351
- D14: Dictionary of Science and Technology, 1981,
page 1076
- D15: Meyers Lexikon, Technik und exakte
Naturwissenschaften, Bibl. Institut AG Mannheim
1970, page 2226
- D16: Dubbel, Taschenbuch für den Maschinenbau,
16. Aufl., 1987, pages E31-E33
- D17: Japanese Book of Technology, Mechanofusion, Nikkan
Kogyo Shinbun, 01.06.1989 with partial English
translation
- D18: Manufacturing Technology Review, Vol. 2, 1987,
15th North American Manufacturing Research
Conference Proceedings, May 27-29, 1987, Lehigh
University, Bethlehem, Pennsylvania, content and
pages 636-640
- D19: E-Mail from Prof. J.P. Kruth
- D20: EP-B2-0 287 657 pages 1, 2, 9, 10
- D21: EP-B1-0 287 657 pages 1, 2, 9, 10
- D22: Larousse Dictionary of Science and Technology,
1995, page 227
- D23: Whittington's Dictionary of Plastics, 1978,
Page 292

D24: Meyers Lexikon der Technik und der exakten
Naturwissenschaften, Bibl. Institut
Mannheim/Wien/Zürich 1969, page 826

IV. On 27 March 2000 the Appellant (Opponent) lodged an
appeal against this decision and paid the appeal fee on
the same date.

In its statement of grounds of appeal filed on 6 June
2000 the Appellant additionally relied upon:

D25: Reichstein, H.: Beschreibung und Entwicklung von
Polymersinterverfahren, Dissertation 1982 RWTH
Aachen, table of contents and pages 1-3

D26: Menges, Georg: Werkstoffkunde Kunststoffe,
3. Aufl. Hanser Verlag München/Wien 1990,
pages 38-39

D27: Polymere Werkstoffe, Thieme Verlag Stuttgart/New
York 1985, pages 12-13, 22-23

D28: Meyers Lexikon der Technik und der exakten
Naturwissenschaften, Bibl. Institut AG Mannheim
1970, page 2365

D29: Ernst, Richard, Dr.-Ing.: Wörterbuch der
Industriellen Technik, Band II, 5. Aufl., Oscar
Brandstetter Verlag Wiesbaden 1985

V. In its communication dated 6 December 2001 the Board
pointed out that discussion would be necessary as to
whether the features of claim 1 were supported by the
application as originally filed. If this condition was
fulfilled, inventive step would have to be considered.

VI. Together with letter dated 28 March 2002 the Appellant
cited furthermore:

D30: Patent Abstracts of Japan, JP-A 63-286533
D30a: JP-A 63-286533
D30b: Partial English translation of D30a
D31: Patent Abstracts of Japan, JP-A 55-085601
D32: Patent Abstracts of Japan, JP-A 57-152438
D26a: Menges, Georg: Werkstoffkunde Kunststoffe,
2. Aufl. Hanser Verlag 1984, pages 38-40
D33: DE-C-44 10 046
D34: EP-B-0 755 321, first page and claims

VII. Oral proceedings were held on 27 June 2002.

The Appellant requested that the decision under appeal be set aside and that the European patent No. 416 852 be revoked.

The Respondent (Patentee) requested that the appeal be dismissed and that the patent be maintained on the basis of

- claims 1 to 12,
- description pages 2 to 10 and
- figures 1 to 14,

all filed during the oral proceedings.

Amended claim 1 reads as follows:

"A method of producing a part comprising the steps of depositing a layer of powder onto a target surface (26, 102), irradiating a selected portion of the powder corresponding to a cross-sectional region of the part to be produced with a directed energy beam (64) in order to sinter the selected portion, repeating the depositing and irradiating steps for a plurality of layers (54, 55,

56, 57) so that bonded portions of adjacent layers bond to one another to form a mass (52), and removing unbonded portions of the powder to yield the mass (52), characterised in that the powder comprises particles of a first material (1002) coated with a second material (1001), said second material (1001) having a lower softening temperature than the first material (1002), said irradiating step results in the second material (1001) in the selected portion of the powder bonding particles of the first material (1002) at the irradiated locations, and wherein, after said removing step, the yielded mass (52) is annealed."

VIII. In support of its request the Appellant essentially relied upon the following submissions:

The term "softening temperature" in claim 1 characterising the second material could not clearly be derived from the application as originally filed because only "bonding temperature" and "dissociation temperature" was disclosed there. Since the "softening temperature" or "Erweichungstemperatur" had a distinct meaning and was only defined for polymers and other amorphous materials claim 1 would have to be restricted to those materials. Furthermore, as was demonstrated during the oral proceedings using a rod of plastic, softening and bonding of that plastic occurred at different temperatures, and therefore "softening temperature" and "bonding temperature" were different properties. In the technical dictionaries the bonding temperature and the dissociation temperature for different plastics did not correspond with one another. For instance two different plastics having the same dissociation temperature had different bonding temperatures or even the one a higher dissociation

temperature and a lower softening temperature than the other, such that when using them in the method of claim 1 it could not clearly be defined which of them was that having the lower bonding temperature. In any case, since there was a lack of disclosure of the term "softening temperature", claim 1 did not meet the requirements of Article 123(2) EPC.

A further lack of original disclosure was the fact that the property of lower softening temperature of the second material was not included in the original claim 40 on which the valid claim 1 was based. The introduction of that isolated feature from the description into claim 1 was not admissible under Article 123(2) EC.

A similar deficiency existed with respect to claim 4 because only increasing the temperature of the powder mass was originally disclosed (A2-document column 9, lines 57 to 59) whereas increasing the temperature of the powder at a target surface was claimed.

In respect of inventive step the method according to claim 1 was obvious by a combination of the teachings of D2 with D3 or vice-versa, D18 with D2, D30 with D2 or of D3 with D30. Documents D18 and D30 should be admitted to the proceedings because they were highly relevant. Moreover D18 was known by the Respondent, and therefore should have been cited as prior art in the patent specification. The very short document D30 was not found earlier and when compared with the other prior art documents included the step of annealing.

The skilled person having knowledge of the prior art would recognize the general teaching to bond particles

of high melting temperature by coating these particles with a material of lower bonding temperature. The step of heat treating or annealing would be carried out in cases when parts of distinct material properties were needed without involving an inventive step.

IX. The submissions of the Respondent are summarised as follows:

The term "softening temperature" was sufficiently supported by the disclosure of the application as originally filed. The point was that the temperature at which the powder was sintered caused viscous flow only at contiguous boundaries of particles with at least some portion of each particle remaining solid. The skilled person reading the description (A2-document column 5, lines 19 to 23) would clearly understand that meaning of the claimed teaching, and no interpretation of the meaning of "bonding temperature" in view of the technical dictionaries was necessary since the original disclosure was clear and unambiguous.

The documents filed after the expiry of the opposition period should not be admitted since there was no reason why they could not be presented by the Appellant in due time.

The method now claimed according to claim 1 was novel and non-obvious when compared with the cited prior art documents. Particularly D2 disclosed generally the mold forming of a part, but no sintering of a high temperature material coated with a low temperature material. According to D3 only composite material was used, and no annealing was disclosed there. Therefore the skilled person would not combine the teachings of D2

with D3. Also D18 did not mention a coated powder, and no indication was given to use a high temperature material coated with a low temperature material. Particularly the shrinkage problem was solved by the combination of features and steps used in the method of the patent in suit including annealing, and obviousness of the claimed solution could only be presumed by ex-post-facto analysis.

Reasons for the Decision

1. The appeal is admissible.
2. *Admissibility of late filed documents*
 - 2.1. According to the case law of the Boards of Appeal late-filed evidence can only be taken into consideration by the Board if it is prima facie more relevant with respect to the subject-matter claimed than the prior art documents already present in the proceedings unless the Patentee agrees with the introduction of the new evidence (see G 9/91, OJ 1993, 408). In the present case the step of heat treatment of a sintered part is explicitly disclosed in document D18 as being prior art while according to D3 reference is only made to post formation treatment in general. That additional feature is of relevance for the consideration of inventive step. The Appellant who had lost the opposition proceedings should be given the opportunity to fill the gap in its arguments by presenting further evidence in the second instance. Therefore the Board admitted D18 into the proceedings.
 - 2.2. In contrast to the above circumstances the Board does

not see that the documents filed with letter of 28 March 2002 would be of higher relevance than the prior art documents already introduced into the proceedings. Also with respect to the short time of filing before the oral proceedings D30 to D34 are disregarded by the Board (Article 114(2) EPC).

3. *Amendments and disclosure*

- 3.1 Considering the Appellant's objections with regard to the term "softening temperature" the following considerations apply.

The skilled person in the present case is considered to be a materials processing engineer experienced in the field of sintering. This person has general knowledge of sintering processes which are typically carried out at a temperature below the melting temperature of the material to be sintered. Reading the patent application documents (see page 4, line 35 to page 5, line 1; page 7, lines 31 to 35; page 17, lines 30 to 34; page 39, claim 40; or A2-document: column 3, lines 17 to 20; column 5, lines 23 to 27; column 12, lines 46 to 51; column 27, claim 40) this skilled person is aware of the fact that sintering of the particles is caused by their melting and bonding at contiguous boundaries while some portion of the particle remains solid. Claim 1 therefore merely explains how selective sintering is achieved in the present case and that the characterising feature of the second material defined by its "softening temperature" is not to be understood as the definition of the "softening temperature" as a specific material property but rather indicates that the sintering is limited to the material of the boundaries of the particles. Since the disclosure of the patent is

consistent and fully within what the skilled person expects when dealing with a selective sintering process he would not consider another, different technical meaning of the term "softening temperature" such as suggested by the Appellant.

- 3.2 With respect to the further objection raised by the Appellant according to which the property of lower softening temperature of the second material was not disclosed in the original claim 40 on which the valid claim 1 is based, the skilled person understands immediately the relation of the core material and the coating material when reading the description of the application as filed (see page 18, line 7 to page 19, line 28; or A2-document: column 13, line 3 to column 14, line 9). The examples given there indicate clearly the method of selective sintering when applying the coated powder comprising the high temperature first material and the low temperature second material.
- 3.3 Having regard to claim 4 which is dependent on claim 1 it is clear that bonding of each deposited layer by irradiation is carried out on the target surface of these layers. Therefore, when the temperature of the powder mass is increased by conventional heating means (see A2-document column 9, line 55 to column 10, line 2) this target surface is self-evidently also increased thus allowing the use of an energy beam merely supplying a small increase of energy.
- 3.4 In view of the above conclusions the Board is satisfied that the amended patent does not give rise to objections under Article 123(2) and 84 EPC.

4. *Novelty*

Novelty of the subject-matter of claim 1 was not contested by the Opponent. The Board is satisfied that none of the cited prior art documents discloses a method with all the steps and features of claim 1.

5. *Inventive step*

5.1 The closest state of the art is represented by D18 which document discloses a method of producing a part including the steps of the pre-characterising portion of claim 1 using a mixture of metal powder and plastic binder wherein, after removing unbonded portions of the powder, the yielded mass is heated (page 637, point 7; page 638, point 4).

5.2 Starting from such a known method the objective problem to be solved by the invention is to produce a final part of better homogeneity and quality.

5.3 This technical problem is solved by a system comprising the steps and features of claim 1. Particularly by using a powder comprising particles of a first material having a high softening temperature coated with a second material having a lower softening temperature than the first material it can be ensured that the selective sintering takes place at the boundaries of virtually each particle. Furthermore, shrinking of the part after sintering can be avoided by the selection of a thin coating, and via the following step of annealing, the coating dissociates and the part can be formed to its final shape (see patent in suit column 9, lines 6 to 33).

5.4 D18 discloses exclusively the use of powder or a mixture of powder in the method of forming a part by sintering. Since any indication is lacking for the use of a powder comprising particles of a first material coated with a second material having a lower softening temperature than the first material these features are non-obvious when compared with the teachings of document D18 alone.

5.5 The Appellant was of the opinion that the skilled person would arrive in an obvious manner at the method of claim 1 when combining the teachings of D18 with those of D2.

D2 discloses a molding process for forming a three-dimensional article wherein planar layers of material are sequentially deposited and a portion of each layer is selectively solidified by using heat (see abstract). According to a single distinct embodiment the fusible particles fused by a laser beam may be of a suitable plastic or plastic-coated sand (see column 7, lines 44 to 50). However, this embodiment based on sand particles does not suggest any heat treatment after forming the part.

5.6 Therefore, since the sintering process of D18 and the molding process of D2 are principally different forming methods, the one of them requiring an annealing step whereas in the other one heat treating would not be useful, the skilled person has no reason to draw a combination of the teachings of D18 with D2 into consideration, and even if he would, that combination would not result in the method of claim 1 because the final step of annealing according to the claimed method is not applicable after mold-forming plastic-coated sand.

- 5.7 The Appellant further submitted that the claimed invention was obvious by a combination of D3 with D2 or of D2 with D3.

D3 and D18 are publications by the same author and their disclosure corresponds with one another in that both of them relate to a method for producing parts by selective sintering. In the example of D18 (see page 638, point 4) heat treating is an obligatory step whereas according to D3 postformation treatments such as heat-treating is only required to achieve certain material properties of the sintered part. When such a produced part is used as a die for sandcast, then post-formation treatment may not be necessary (see page 15, line 31 to page 16, line 6). Insofar with regard to the method of claim 1 of the patent in suit the disclosure of D3 does not extend over that of D18, and the reasons given above in respect of obviousness by a combination with the teachings of D2 apply in the same manner.

When starting from D2 and drawing a combination with D3 into consideration, the step of heat-treating of the part made according to the method of D2 is not applicable as stated above. Therefore the skilled person would be hindered from using this step of the sintering process according to D3 in the molding process of D2. Consequently, since the steps and features of the method according to claim 1 of the patent in suit in their specific combination cannot be arrived at in an obvious manner the subject-matter claimed involves an inventive step (Article 56 EPC).

- 5.8 The further documents cited during the opposition proceedings, which have no longer been referred to in the appeal proceedings, do not come closer to the

subject-matter of claim 1 than the documents discussed above. Therefore they also cannot lead to the method of claim 1 either.

6. Summarizing, in the Board's judgment, the proposed solution to the technical problem underlying the patent in suit defined in the independent claim 1 is inventive and therefore this claim as well as its dependent claims 2 to 12 relating to particular embodiments of the invention in accordance with Rule 29(3) EPC, can form the basis for maintenance of the patent (Article 52(1) EPC).

Thus taking into account the amendments made by the Appellant, the patent and the invention to which it relates meet the requirements of the EPC and the patent as amended is maintained in this form (Article 102(3) 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 1 to 12,
- the description, pages 2 to 10 and
- figures 1 to 14,

all filed during the oral proceedings.

The Registrar:

The Chairman:

D. Sauter

P. Alting van Geusau