

BESCHWERDEKAMMERN
DES EUROPÄISCHEN
PATENTAMTS

BOARDS OF APPEAL OF
THE EUROPEAN PATENT
OFFICE

CHAMBRES DE RECOURS
DE L'OFFICE EUROPEEN
DES BREVETS

Internal distribution code:

- (A) [] Publication in OJ
(B) [] To Chairmen and Members
(C) [X] To Chairmen
(D) [] No distribution

**Datasheet for the decision
of 1 June 2006**

Case Number: T 0911/00 - 3.3.07

Application Number: 90108074.7

Publication Number: 0395091

IPC: D01F 9/08

Language of the proceedings: EN

Title of invention:

Sintered sol gel alumina based filament and method for making
and use of same

Patentee:

NORTON COMPANY

Opponent:

Minnesota Mining and Manufacturing Company

Headword:

-

Relevant legal provisions:

EPC Art. 56

Keyword:

"Inventive step (yes) - problem and solution - (non-obvious
solution)"

Decisions cited:

-

Catchword:

-



Case Number: T 0911/00 - 3.3.07

D E C I S I O N
of the Technical Board of Appeal 3.3.07
of 1 June 2006

Appellant: NORTON COMPANY
(Patent Proprietor) 1 New Bond Street
Worcester, MA 01615-0008 (US)

Representative: Diehl, Hermann O. Th.
Diehl & Partner
Postfach 34 01 15
D-80098 München (DE)

Respondent: Minnesota Mining and Manufacturing Company
P.O. Box 33427
St. Paul, Minnesota 55133-3427 (US)

Representative: Vossius & Partner
Siebertstrasse 4
D-81675 München (DE)

Decision under appeal: Decision of the Opposition Division of the
European Patent Office posted 13 July 2000
revoking European patent No. 0395091 pursuant
to Article 102(1) EPC.

Composition of the Board:

Chairman: S. Perryman
Members: B. Struif
B. ter Laan

Summary of Facts and Submissions

I. The mention of the grant of European patent No. 0 395 091 with respect to European patent application No. 90 108 074.7 filed on 27 April 1990 was published on 18 December 1996. The granted patent was based on sixteen claims. Independent claims 1, 10, 15 and 16 read as follows.

"1. Sintered sol gel alumina based ceramic bodies comprised of sintered alpha alumina crystals, having a diameter not greater than 1.5 mm, and average aspect ratio of at least 1.0 and a Vickers hardness of at least 16 GPa

wherein

said sintered sol gel alumina based ceramic bodies are filamentary abrasive particles having a substantially uniform cross-section, whereby the sintered alpha alumina crystals have a size not greater than 2 μm , preferably not greater than 1 μm ."

"10. A method of making a sintered sol-gel alumina based ceramic body, the bodies containing alpha alumina crystals comprising the steps of:

providing a gelled dispersion of sub-micron hydrated alumina particles,

shaping said gelled dispersion into filaments, drying the filaments, and firing said dried filaments, wherein

the filaments are filamentary abrasive particles having a substantially uniform cross-section, a

diameter not greater than 1.5 mm and an average aspect ratio of at least 1.0, the filaments being fired to a temperature between 1090°C and 1500°C for a time selected to convert the alumina in said filaments to a ceramic body, the major portion of which is made up of alpha alumina crystals of 2 µm or less in size, and the filaments having a Vickers hardness of at least 16 GPa."

"15. A sintered sol gel alumina based filamentary abrasive particle obtainable by the method of one of claims 10 to 14."

"16. Use of a filamentary abrasive particle according to one of claims 1 to 9 or 15 in bonded abrasive products, especially grinding wheels or segments or in coated products especially belts or discs."

II. A notice of opposition was filed against the granted patent in which revocation of the patent in its entirety was requested on the grounds of lack of novelty and lack of an inventive step under Article 100, paragraph (a) EPC. The opposition was supported *inter alia* by the following documents:

D1: US-A-4 623 364

D2: US-A-4 786 292

D5: EP-A-0 293 163

D6: EP-A-0 168 606

After the nine months time limit for opposition the following further document was cited by the opponent:

D14: EP-A-0 291 029

III. By a decision posted on 13 July 2000, the opposition division revoked the patent. That decision was based on two sets of 14 claims each, submitted during the oral proceedings, as the main and one auxiliary request. Claim 1 of the main request read as follows:

"Sintered sol gel alumina based ceramic bodies consisting of sintered alpha alumina crystals, having a diameter not greater than 0.5 mm, and average aspect ratio of from 1.5 to 25, a Vickers hardness of at least 16 GPa, a density of at least 95% of theoretical density, and of optionally 1 to 50% by weight of an oxide selected from the group consisting of titania, magnesia, hafnia, ceria, manganese dioxide, and mixtures thereof

wherein

said sintered sol gel alumina based ceramic bodies are filamentary abrasive particles having a substantially uniform cross-section, whereby the sintered alpha alumina crystals have a size not greater than 2 μm , preferably not greater than 1 μm ."

Claim 1 of the auxiliary request read as follows:

"Sintered sol gel alumina based ceramic bodies consisting of sintered alpha alumina crystals, having a diameter not greater than 0.5 mm, and average aspect ratio of from 1.5 to 25, a Vickers hardness of at least 16 GPa, a density of at least 95% of theoretical density, and of up to 15% by weight of an oxide selected from the group consisting of titania, magnesia,

hafnia, ceria, manganese dioxide, precursors of these oxides and mixtures thereof

wherein

said sintered sol gel alumina based ceramic bodies are filamentary abrasive particles having a substantially uniform cross-section, whereby the sintered alpha alumina crystals have a size not greater than 1 μm ."

The opposition division held that:

- (a) The claimed subject-matter of the main and the auxiliary request complied with Article 123 paragraphs (2) and (3) EPC.
- (b) The late filed document D14 was considered to be relevant and admitted to the proceedings. None of D1, D2, D5, D6 and D14 was prejudicial to the novelty of the main as well as of the auxiliary request.
- (c) D14 was considered to be the closest prior art document. The claimed subject-matter differed from D14 only in that the diameter of the sintered sol gel alumina based ceramic bodies was not greater than 0.5 mm and did not contain any zirconia. In view of D14 itself as well as of D1, the absence of zirconia was obvious and would not contribute to an inventive step. The filament diameter as claimed did not provide any surprising technical effect. Hence, the distinguishing features over D14 could not substantiate an inventive step.

(d) According to claim 1 of the auxiliary request, the size of the sintered alpha alumina crystals was restricted to being not greater than 1 μm . Since that feature was already mentioned in the closest prior art document D14, the considerations outlined with respect to the main request also applied to the auxiliary request.

IV. On 11 September 2000, the proprietor (appellant) filed a notice of appeal against the above decision, the prescribed fee being paid on the same day. The statement setting out the grounds of appeal was filed on 16 November 2000.

V. With letter dated 27 January 2006, in reply to a communication of the board, the appellant filed an amended set of claims 1 to 11 and an adapted description as new main request.

VI. On 1 June 2006, at the oral proceedings before the board, the appellant submitted a set of claims 1 to 5 (main and sole request) and adapted description pages 2 and 15. In that set of claims all granted method claims were cancelled. Claim 1 reads as follows:

"Sintered sol-gel alumina based filamentary abrasive particles **consisting of seeded** sol-gel alpha alumina crystals having **a size of less than 1 μm** , said filamentary particles

having a substantially uniform cross-section,

having an average aspect ratio of at least 2,

having a Vickers hardness of at least 16 GPa,

having a maximum cross-sectional dimension of less than 0.5 mm,

being curved or twisted in their longer dimension,

having a density of at least 95% of theoretical density, and,

optionally, including 1 to 50%, by weight, of an oxide selected from the group consisting of zirconia, titania, magnesia, hafnia, ceria, spinel, mullite, manganese dioxide, and mixtures thereof." (Emphasis added by the board to indicate amendments vis-à-vis the granted version).

Claims 2 to 4 refer to preferred embodiments of claim 1. Claim 5 is directed to the use of the filamentary abrasive particles according to any of the previous claims in bonded abrasive products.

VII. The appellant argued in substance as follows:

- (a) The application as filed provided a basis for the amendments. Reference was made in particular to original claims 5, 7 and 8 as well as to description page 5, lines 23 to 25. The references to the precursors of oxides had become redundant. It was pointed out that the term "consisting of" in respect of the seeded sol-gel alpha alumina crystals and the restricted list of the optional oxide components had been accepted in the decision under appeal.

(b) As regards inventive step, D14, which was the closest document, related to high duty grinding materials having a diameter of 0.6 mm or more and designed to withstand high bending forces. It contained no incentive to prepare smaller diameter filaments in order to provide advantageous properties in high precision operations. The skilled person was faced with technical difficulties in making fine filamentary fibres and he would have no expectation of advantage from the use of such abrasives in high precision grinding. Furthermore, claim 1 was now restricted to curved or twisted filamentary particles which provided specific advantages as described in the patent in suit and which feature was not rendered obvious by the cited prior art documents.

VIII. The respondent (opponent) did not argue against the present main request. In particular, no objections were raised against the amendments made to the claims and no arguments against inventive step were presented.

IX. The appellant requests that the decision under appeal be set aside and that the European patent be maintained on the basis of claims 1 to 5 submitted at the oral proceedings as the sole request and amended description pages 2 and 15 submitted at the oral proceedings and pages 3 to 10 and 16 to 17 submitted with letter dated 27 January 2006 and pages 11 to 14 and 18 of the patent specification as granted.

X. The respondent requests that the appeal be dismissed.

Reasons for the Decision

1. The appeal is admissible.

Amendments to the claims

2. The basis in the application as filed for the amendments to claim 1 is as follows:

- original claim 1;
- original claim 5: "having a density of at least 95% of theoretical density and, optionally, including 1 to 50%, by weight, of an oxide selected from the group, consisting of zirconia, titania, magnesia, hafnia, ceria, spinel, mullite, manganese dioxide, and mixtures thereof";
- original claim 6: "seeded sol-gel alpha alumina crystals having a size of less than 1 μm ";
- original claims 7 and 8: "being curved or twisted in their longer dimension";
- original page 5, lines 23 to 25: "having a maximum cross-sectional dimension of less than 0.5 mm";
- original page 10, lines 19 and 20: "having an average aspect ratio of at least 2".

2.1 The corresponding basis in the patent as granted is as follows: claims 1, 5 to 8; description, page 3, lines 30 and 31 and page 4, line 58.

2.2 All the features of original claim 5 except for the term "precursors of the oxides" have been incorporated in claim 1. Since by sintering possible precursors of

the oxides have been converted to the corresponding oxides, those precursors need not be present in the final sintered abrasive particles. The term "comprised of" in original claim 1 has been replaced by the term "consisting of" so that the sintered sol-gel alumina based filamentary particles now consist of seeded sol-gel alpha alumina crystals (original claim 6) optionally including 1 to 50% by weight of the oxides of the specified list (original claim 5).

2.3 Claims 2 to 5 as amended go back to claims 3, 4, 9 and 16, respectively, as granted. Those claims have been adapted to the amendments of claim 1.

2.4 Therefore, the amendments made to the claims can directly and unambiguously be derived from the application as filed and result in a restriction of the claimed subject-matter compared to the granted version. Consequently, the amendments to the claims meet the requirements of Article 123, paragraphs (2) and (3) EPC.

Novelty

3. Novelty had been accepted in the decision under appeal and was not an issue in the appeal proceedings. The board sees no reason to take a different view in that respect, as also becomes apparent from the discussion of inventive step below.

Inventive step

Problem and solution

4. The patent in suit concerns sintered sol-gel alumina based filaments. Such filaments are known from the prior art, in particular D14, which the decision under appeal and the respondent regarded as the closest prior art document. The appellant did not object to that approach. The board sees no reason to take a different starting point.
- 4.1 D14 discloses a ceramic body comprising well intermixed microcrystals of alpha-alumina and zirconia and containing from 50 to 95 weight percent of alumina and from 50 to 5 weight percent of zirconia, wherein at least three-fourths of said microcrystals appear to have a maximum dimension between 0.25 and 1 micron when viewed in cross section in an electron micrograph at a magnification of about 10,000 - 20,000 X (claim 1). The hardness of the ceramic body is preferably at least 17 GPa (claim 5). Those ceramic bodies are preferably made by extruding a seeded alumina sol-gel containing zirconia powder into rods, which are dried, crushed and fired (page 5, lines 13 and 14).
- 4.2 In example 1 of D14 an alumina monohydrate sol is made with fine alpha alumina seeds and stabilized as well as unstabilized zirconia powder. The sol is gelled and formed to pellets and then extruded to provide short rods of about 2.4 mm in diameter. The rods are dried and broken into short lengths having an aspect ratio between 1 and 10 and a diameter of about 1.6 mm. After a heat treatment the short lengths of material are

- graded for abrasive grits and the fraction classified as grit 16, with an average size of 1.2 mm, is used to make grinding wheels.
- 4.3 Whilst in examples II and III of D14 rods having dimensions identical to that indicated in example I are described, according to examples IV to VIII ceramic fibre bodies with a diameter of 0.6 mm are prepared using different amounts of zirconia. The hardness of those fibres is from 17.8 GPa (50% by weight of zirconia) to 20.0 GPa (5% by weight of zirconia) which is within the claimed range.
- 4.4 D14 aims at alumina-zirconia sintered abrasives which are superior to their fused counterparts in overall performance in the "snagging" (heavy duty grinding) of both stainless and carbon alloy steels (page 3, lines 51 to 53).
- 4.5 From the above it follows that D14 discloses seeded sol-gel alpha alumina based abrasive particles obtained by extrusion, which include alpha-alumina crystallites having a size of less than 1 μm . The known particles have an aspect ratio and hardness within the claimed range, and a diameter that comes close to that of the claimed filamentary abrasive particles.
- 4.6 Hence, claim 1 differs from D14 essentially in that the sintered filamentary particles have a maximum cross-sectional dimension of less than 0.5 mm and are twisted or curved in their longer dimension.
- 4.7 Although the experimental results of the patent in suit show that the claimed abrasive particles have good

- performance in different grinding applications and show some improvements over blocky shaped sintered seeded sol gel and roll crushed abrasive grains, no comparison with filamentary abrasive particles according to D14 is given from which a specific technical effect could be seen as a consequence of the lower cross-sectional dimension compared to D14.
- 4.8 According to the patent in suit, the twisted or curved configuration of the filaments may be superior to their straight counterpart in bonded abrasive applications and make the abrasive filaments so shaped more difficult to pull out of its bond. In addition, such curved and twisted abrasive filaments make it easier to obtain desired ranges of loose packed density in grinding wheels (page 5, lines 6 to 14). However, there are no tests on file showing an improvement over filamentary particles of D14 in that respect.
- 4.9 Alleged advantages (here superior properties of the twisted or curved configuration over their straight counterparts) to which the patent in suit merely refers without offering sufficient evidence supported by any comparison with the closest prior art, cannot be taken into consideration in determining the problem underlying the invention (compare Case Law, *supra*, I.D.4.4).
- 4.10 Hence, the problem solved has to be formulated in a less ambitious way and may be seen in providing alternative sintered sol-gel alpha alumina based abrasive particles having similar properties to those of D14.

Obviousness

5. It remains to be decided whether the claimed subject-matter is obvious having regard to the documents on file.

5.1 In D14, there is no mention that the sol-gel abrasive filaments are curved or twisted and should have a maximum cross-sectional dimension of less than 0.5 mm. There is no evidence on file that the curved or twisted configuration would be automatically or randomly obtained in a conventional extrusion process. Consequently, there is no incentive in D14 to make such a modification of the abrasive particles. Thus, D14 alone does not render the claimed subject-matter obvious.

5.2 None of the other cited documents would lead to the sintered sol-gel alpha alumina based abrasive particles now being claimed.

5.2.1 D1 discloses a method of making ceramic bodies containing alpha alumina having a hardness of greater than 16 GPa, a density greater than 90%, and an alpha-alumina particle size below one micron comprising providing a dispersion of submicron hydrated alumina particles, said dispersion including an effective amount of submicron alpha-alumina crystals, whereby upon drying and firing said hydrated alumina particles are converted to alpha-alumina at a temperature below 1100°C, and firing said body to below 1500°C (claim 1).

5.2.2 According to example I of D1, an alumina gel containing MgO is formed to equiaxed particles (crystallites) of

- 0.2 to 0.4 micron in diameter and having a hardness of 19 GPa. According to example X, which refers to example I, particles of 54 grit are produced which correspond to a diameter of 0.3 to 0.35 mm.
- 5.2.3 According to the description of D1, the material may be formed by crushing the dried gel or by molding into shaped particles by extrusion. In the case of extrusion, the rods formed would later be cut or broken into appropriately sized pieces (column 2, lines 62 to 66). However, there is no disclosure that such filaments should have a maximum cross-sectional dimension, an aspect ratio and a curved or twisted configuration as now claimed.
- 5.3 D2 discloses a method of manufacturing a sintered, microcrystalline alpha-alumina abrasive material having a purity of at least 98.5% and a density of at least 95% of theoretical density, the alpha-alumina crystallites of the material being smaller than 4 μm , which comprises the steps of (a) preparing a mixture of finely milled, calcined alumina and 1 to 60%, by weight, of a highly dispersable alpha-aluminum oxide monohydrate, (b) reacting said mixture with water and an acid, (c) homogenizing the reacted mixture until a formable mass has been obtained, (d) forming the mass into shaped bodies, and (e) sintering the shaped bodies for 5 minutes to 2 hours at a temperature between 1300°C and 1700°C (claim 1). The formable mass is preferably pressed or extruded through a matrix to obtain strands of uniform cross section (column 2, lines 50 to 52). D2 aims at a simple and cost-effective method of manufacturing abrasive material, which has a high density and tenacity and the grains of which have

a harder surface than alumina abrasive material available at that time (column 1, lines 48 to 54).

According to example 2 of D2, the extruded strands are cut in sections having a length of 2.5 to 4.4 mm and a diameter of 2.2 mm. The sintered material has an average diameter of 1.7 mm and a length of 3.3 mm. Thus, the diameters of the sintered filamentary particles of D2 are far outside the now claimed range. Hence, there is no incentive in D2 for providing a curved or twisted configuration of the sintered particles having a maximum cross-sectional dimension of less than 0.5 mm.

- 5.4 D5 discloses ceramic abrasive grits comprising alpha-alumina characterized by at least one modifying additive metal selected from the group consisting of zirconium, hafnium, cobalt, nickel, zinc, magnesium, yttrium, praseodymium, samarium, ytterbium, neodymium, lanthanum, gadolinium, cerium, dysprosium, erbium, and combinations of two or more of such metals, wherein the concentration of said modifying additive metal is greater at or near the surface of said grit than at the interior of said grit (claim 1). D5 aims at ceramic abrasive grits, which have superior abrasive performance in abrading certain workpieces (page 3, lines 17 and 18). Since the abrasive particles of D5 are produced by crushing (page 3, line 37), no filamentary particles having an average aspect ratio of at least 2 are obtained. Furthermore, D5 concerns the concept of an impregnation process (page 3, lines 42 to 44), which is quite different from providing filamentary particles having a curved or twisted configuration.

5.5 D6 discloses a method for making polycrystalline alpha alumina bodies having a submicron crystal size from dispersable alumina hydrate powders comprising mixing said powders with water, with submicron alpha-alumina seed, and with acid, to a solids content of greater than 25%, exerting a pressure on the mixture, and firing the resulting body having a porosity of less than 10% (claim 1). Sintered seeded sol-gel fibres are formed by extruding a paste of seeded alumina monohydrate through an piston extruder, then drying and sintering (example I). In example III, abrasive particles are produced by impact crushing and sintering the extrudate to obtain a grain having a size of 50 grit (about 0.28 mm; see patent in suit page 4, line 12). However, in D6 no filamentary particles having a cross-sectional dimension, aspect ratio and curved or twisted configuration as now claimed are disclosed.

5.6 From the above it follows that in none of the documents cited above a curved or twisted configuration of the filaments has been considered for providing alternative abrasive particles, let alone in combination with a cross-sectional dimension and aspect ratio as claimed. There is no incentive in those prior art documents to modify the teaching of D14 in the direction of the claimed subject-matter. Hence, a combination of one or more of those documents with D14 does not render the claimed subject-matter obvious.

5.7 The further documents cited during the proceedings are less relevant than those analysed above and do not render the claimed subject-matter obvious either.

5.8 From the reasons given above (points 4. to 5.7) it is evident that even when starting from a cited document other than D14 as the closest state of the art, no other conclusion would be reached.

5.9 Thus, the claimed subject-matter involves an inventive step.

6. The version of the new claims has been considerably amended and a thorough adaption of the description is needed. Although the appellant has already submitted an amended description, the final check thereof is left to the department of first instance. Specific attention should be given to the fact that the process claims have been cancelled. In table XV, sample G has a crystal size outside the claimed range and should be marked correspondingly (see also the amendment made at the bottom of page 16).

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 claims 1 to 5 submitted at the oral proceedings on 1 June 2006 and a description to be further adapted if necessary.

The Registrar

The Chairman

C. Eickhoff

S. Perryman