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**D E C I S I O N**  
**of 28 March 2000**

**Case Number:** T 0700/97 - 3.2.3

**Application Number:** 91103309.0

**Publication Number:** 0454970

**IPC:** B24D 3/14, C04B 35/10

**Language of the proceedings:** EN

**Title of invention:**  
Vitrified bonded abrasive article

**Applicant:**  
NORTON COMPANY

**Opponent:**  
-

**Headword:**  
-

**Relevant legal provisions:**  
EPC Art. 56  
EPC R. 88

**Keyword:**  
"Inventive step (claim amended, yes)"

**Decisions cited:**  
-

**Catchword:**  
-



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Boards of Appeal

Chambres de recours

**Case Number:** T 0700/97 - 3.2.3

**D E C I S I O N**  
**of the Technical Board of Appeal 3.2.3**  
**of 28 March 2000**

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

**Representative:** Zimmermann, Gerd Heinrich  
Zimmermann & Partner  
P.O. Box 33 09 20  
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**Decision under appeal:** Decision of the Examining Division of the  
European Patent Office posted 11 February 1997  
refusing European patent application  
No. 91 103 309.0 pursuant to Article 97(1) EPC.

**Composition of the Board:**

**Chairman:** C. T. Wilson  
**Members:** J. du Pouget de Nadaillac  
J. P. B. Seitz

## Summary of Facts and Submissions

I. The appeal is directed against the decision dated 11 February 1997 of an Examining Division of the European Patent Office, which refused the European patent application EP-A1-0 454-970 for lack of an inventive step of the claimed subject-matter, having regard to the disclosure of documents D1 and D2, among the following prior art citations which were considered during the examination proceedings:

D1: US-A-4 800 685

D2: US-A-4 543 107

D3: EP-A-0 242 955

D4: Patent abstracts of Japan vol. 12, No. 190  
(M-704)(3037), 3 June 1988, and JP-A-62 297 070.

D5: EP-A-0 351 134

II. The appellant (applicant of the patent application) lodged the appeal on 2 April 1997 and paid the appeal fee on the same day. In the statement of grounds filed on 10 June 1997, he essentially contested the reasons of the decision on appeal and requested a patent to be granted on the basis of the claims attached to the impugned decision. Auxiliarily, it was requested that a term for oral proceedings be set.

In reply to a communication of the board of appeal, which was attached to the summons to oral proceedings, he filed on 17 December 1999 further set of claims as

auxiliary requests I to III and joined to his comments a declaration of Dr Krishnamoorthy Subramanian, Director in the Higgins Grinding Technology Center, Research & Development, Abrasives Branch of the appellant.

Oral proceedings were held on 18 January 2000. During these proceedings, the subject-matter of a new amended Claim 1 was discussed and it was requested to continue the proceedings in writing.

On 27 March 2000, the appellant filed an amended description and a new set of claims.

III. Claim 1 of this set reads as follows:

"A vitrified bonded abrasive article for grinding hard-to-grind metals comprising a mixture of from 10 to 90% by volume of sintered seeded sol gel aluminous abrasive grains comprising submicron sized alpha alumina crystals and 90 to 10% by volume of silicon carbide grains and an inorganic glassy bond therefor, wherein said inorganic glassy bond is matured at 1200°C or below."

Dependent Claims 2 to 10 follow.

IV. The appellant substantially argued as follows:

The citation D2 concerns the grinding of hard-to-grind materials and discloses a vitrified bonded abrasive article comprising sintered seeded sol gel aluminous abrasive grains comprising submicron sized alpha alumina crystals and an inorganic glassy bond. The

object of the patent application in suit is to improve the grinding performance of such an abrasive article, which above all means an improvement of the grinding ratio when hard-to-grind grinding is concerned. The utilization of silicon carbide in combination with a sol gel alumina is disclosed in document D1 for a different application, namely for the grinding of cast iron, commonly called snagging. For this different grinding application, the important factor is the metal removal rate, and not the grinding ratio, and Table 2 of D1 shows that the addition of silicon carbide grains in an abrasive mixture only improves the metal removal rate, however significantly lowers the grinding ratio compared to an abrasive grit of 100% sol gel alumina. Therefore, contrary to the reasons given in the decision on appeal, this citation D1 cannot suggest the claimed solution.

- V. The appellant requested that the decision on appeal be set aside and that a European patent be granted on the basis of the documents filed on 27 March 2000.

### **Reasons for the Decision**

1. The appeal is admissible.
2. Compared to the Claim 1 upon which the decision on appeal was based, the subject-matter of the new Claim 1 is amended in that it concerns abrasive articles for grinding hard-to-grind metals. This amendment is supported by the passage on page 2, lines 6 to 9 of the description of the patent application, as originally filed. Since all the other features of the claim are

also disclosed in this description, the claim complies with Article 123, paragraph 2, EPC. The description is also amended so as to be adapted to this new claim. In particular, all passages which did not clearly refer to the claimed seeded gel abrasives are amended so as to clearly refer to them. Moreover, the features of the original Claims 3 and 8 are introduced in the description and the prior art document D1 is acknowledged. A value which was missing in the third example of Table IV, namely "70% SG", is also introduced in said example; this value is obvious in view of the 30% Sic green value, which was already given for this example, noticing moreover that all other examples of this table add up to 100%. Thus, the new documents of the patent application are admissible (Articles 84, 123 and Rule 88 EPC).

3. Since none of the cited prior art documents discloses an abrasive article having all the features of Claim 1, the subject-matter of this claim is new (Articles 52 and 54 EPC).
  
4. The subject-matter of this claim concerns abrasive articles for grinding hard-to-grind metals and, therefore, is restricted in comparison with that, on which the decision under appeal is based and which covered any kind of grinding application. As a consequence, the prior art which is the closest to the present invention is represented by the abrasive article described in citation D2, and no longer by the Example 2 of document D1: the grinding wheel according to D2 is provided for grinding tool steels, whereas that of D1 is for grinding cast iron, also called snagging. The requirements of these two kinds of

application are different: according to the filed declaration of Doctor Krishnamoorthy Subramanian , in snagging procedures, which pertain to the class of manual grinding procedures, the important measurement for determining the grinding performance is the total amount of metal removed, or metal removal rate (MRR), since manual procedures permit little control over grinding precision or power consumption during the grinding operation. In contrast thereto, hard-to-grind metals, e.g. titanium metal, titanium alloys and stainless steel, are above all used as precision components and a grinding machine with precision controls is used to achieve closer tolerances, while simultaneously avoiding damaging the surface of the workpiece with too high temperatures. The efficiency and quality of the grinding in this other application can only be accurately measured by measuring the G-ratio ( grinding ratio, which is the total metal removed divided by the total wheel wear) and the power consumption (or power draw), lower power draw indicating less thermal damage to the workpiece during grinding.

5. The abrasive article described in D2 is made of an abrasive grit and an inorganic glassy bond, so that a vitrified bonded article is obtained. The abrasive grit essentially consists of sintered seeded sol gel aluminous abrasive grains comprising submicron sized alpha alumina crystals. It is consequently not a mixture of different abrasive grits. This, however, does not exclude that the alumina gel itself or this abrasive grit may contain magnesia or other additives such as zirconia (D2, column 1, lines 52 to 54; see also the present application as published, page 2,

lines 48 to 50). D2 further teaches that, in order to avoid reactions between the bond and abrasive during the final firing step of the manufacturing of said abrasive article, it is necessary to avoid temperatures above 1200°C.

6. Starting from this prior art, the problem underlying the present patent application is to improve the grinding performance of such an abrasive article, particularly with regard to the power drawdown to achieve a certain G-ratio.

The solution as claimed consists of a mixture of from 10 to 90% by volume of the above mentioned "seeded gel abrasive" grains and 90 to 10% by volume of silicon carbide grains, instead of the "seeded gel abrasive" grains as sole abrasive. The comparative tests given in the description of the patent application in suit show that, in order to achieve a nearly similar G-ratio, the power drawn by the abrasive article as claimed is significantly lower than the power draw of abrasive articles containing only one kind of abrasive grain, that is to say either the silicon carbide grain or the seeded gel abrasive grain. Thus, an unexpected result is obtained.

7. As already mentioned, document D1 concerns snagging procedures, so that the person skilled in the art, confronted with the above-mentioned problem, has no particular reason to consider the teaching of this citation, because he knows that the requirements as to the grinding performance are different. This is confirmed by the aims given in D1: one main object of D1 is to form grinding wheels which grind cast iron at



higher rates of metal removal. The longer life of the abrasive wheels, and thus the G-ratio, is only mentioned as a subsidiary object.

The only disclosed embodiment which comprises silicon carbide is Example 2 of D1. The bonded abrasive article according to this example comprises a mixture of two abrasive grits, namely sintered sol gel alumina abrasive grains, which are not "seeded", and silicon carbide grains, both bonded, preferably by a phenolic resin, but it is also indicated that a vitrified bond may also be used. In Table 2 (column 6) of D1, a consideration of Example 2 and Example 3, this last example concerning a 100% sol gel alumina abrasive, that is to say a single kind of abrasive grain, thus very close to those disclosed in D2, shows that the G-ratio obtained by Example 2, namely 17,1, is significantly lower than the G-ratio of 49,6 provided by Example 3. It is also lower than the G-Ratio given for Example 5, which relates to an abrasive grit of 100% fused alumina. These results confirm the teaching given in column 1 of D1 that silicon carbide causes abrasive articles to wear at an accelerated rate. In fact, D1 mainly teaches the use of silicon carbide as a cost-reducing filler, which is further interesting for snagging, since it also improves the metal removal rate, but at the expense of wheel wear. Therefore, the person skilled in the art, considering the solutions and results which are disclosed in D1, receives no incentive to use silicon carbide grains in combination with seeded gel abrasive grains in order to improve the grinding performances, which are to be considered for the treatment of hard-to grind metals. He is rather encouraged to provide an abrasive article based on a

single abrasive grit, as is already the case in the teaching of D2. It is moreover noticed that D1 provides no information as to the power drawdown factor.

8. The other prior art citations D3 to D5 are less relevant: D3 teaches to **cover** superhard abrasive grains, like diamond, silicon carbide and so on with a gel material made of  $\text{Al}_2\text{O}_3$ - $\text{SiO}_2$  group glass through the gel method. D4 teaches to provide a grinding wheel having a rim and a core of different compositions, the rim having as main component cubic boron nitride mixed with alumina. D5 concerns ceramic cutting tools made of  $\text{Al}_2\text{O}_3$ -SiC whiskers- $\text{ZrO}_2$ , no bonding material being present. Hence, these further documents cannot suggest the present invention.
  
9. The board therefore concludes that the abrasive article according to Claim 1 of the main request was not obvious in the light of the cited prior art. Claims 2 to 10, which depend on Claim 1 and concern further embodiments of the invention, are as a consequence of the patentability of Claim 1 also patentable.

Under these circumstances, there is no need to consider the other requests.

## **Order**

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

1. The impugned decision is set aside.

2. The case is remitted to the first instance with the order to grant a patent on the basis of the documents filed on 27 March 2000, namely:

**Description:** pages 2 to 10, together with Insertions 2a and 3a, and

**Claims:** 1 to 10.

The Registrar:

The Chairman:

A. Counillon

C. T. Wilson