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D E C I S I O N
of 17 November 2005

Case Number: T 1137/04 - 3.2.07

Application Number: 98301438.2

Publication Number: 0938959

IPC: B28D 5/02

Language of the proceedings: EN

Title of invention:
Abrasive-bladed multiple cutting wheel assembly

Applicant:
Shin-Etsu Chemical Co., Ltd.

Opponent:
-

Headword:
-

Relevant legal provisions:
EPC Art. 54, 56

Keyword:
"Disclosure of prior art document"
"Values for Vickers hardness not explicitly stated disclosed through reference to specific types of cemented metal carbides"
"Inventive step (no)"

Decisions cited:
-

Catchword:
-

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Case Number: T 1137/04 - 3.2.07

D E C I S I O N
of the Technical Board of Appeal 3.2.07
of 17 November 2005

Appellant: Shin-Etsu Chemical Co., Ltd
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Tokyo (JP)

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Decision under appeal: **Decision of the Examining Division of the European Patent Office posted 16 March 2004 refusing European application No. 98301438.2 pursuant to Article 97(1) EPC.**

Composition of the Board:

Chairman: C. Holtz
Members: H.-P. Felgenhauer
K. Poalas

Summary of Facts and Submissions

I. The appeal is directed against the decision posted 16 March 2004 of the Examining Division refusing the European patent application No. 98 301 438.2.

The Examining Division held that the application had to be refused since claim 1 lacks inventive step in view of the closest prior art as indicated on pages 4 to 6 and figures 2A and 2B of the application in suit and document

D2: JP-A-09174441 (abstract and translation of the document into English).

In the appeal proceedings documents

D3: Zhengui Yao, Jacob J. Stiglich and T. S. Sudarshan, Materials Modification, Inc. 2929 Eskridge Road, P-1, Faifax, VA 22031 "Nano-grained Tungsten Carbide-Cobalt (WC/Co)", pages 1 to 27 and

D4: five page printout of Internetsite of azom.com "Tungsten Carbide - an Overview"

were submitted by the appellant as evidence for the general technical knowledge in the technical field of the application and in this respect

D5: R. Kiefer, F. Benesovsky "Hartmetalle", Springer-Verlag Wien - New York pages 156, 157

was referred to by the Board.

II. According to the decision under appeal, it was agreed by the Examining Division and the applicant/appellant that the closest prior art was constituted by the assembly shown in figures 2A, 2B and described on pages 4 to 6 of the application as originally filed. In order to solve the problem relating to an increase of dimensional accuracy and reduction of material loss in the process of cutting work pieces from a base block it was considered by the Examining Division to be straightforward to use a cutting assembly as referred to in the entering clause of claim 1 with at least two abrasive-bladed cutting wheels, each of the cutting wheels being made of a material as disclosed in document D2 for a cutting wheel assembly comprising one cutting wheel.

III. The appellant requested that the decision under appeal be set aside and that a patent be granted based on claims 1 to 7 as filed with telefax dated 5 January 2004.

IV. Claim 1 reads as follows:

"1. An abrasive-bladed cutting wheel assembly, the assembly comprising:

(A) a rotation shaft (10);

(B) at least two abrasive-bladed cutting wheels (6), each said cutting wheel comprising a base wheel (1) having a substantially central aperture (5) for insertion of the shaft, and an abrasive blade layer (2) bonded to the outer periphery of the base wheel, wherein each said cutting wheel is fixed on the shaft

inserted into the substantially central aperture thereof, and each abrasive blade layer includes particles of an abrasive material bonded together by means of a bonding agent; and

(C) at least one spacer (3) having a respective substantially central aperture for insertion of the shaft and fixed on the shaft by insertion of the shaft into the substantially central aperture thereof, wherein at least one spacer is located at a position between two abrasive-bladed cutting wheels to define the spacing therebetween,

characterised in that each base wheel includes a cemented metal carbide having a Young's modulus in the range from 45000 to 70000kgf/mm^2 and a Vickers hardness Hv in the range from 900 to 2000."

V. The arguments of the appellant can be summarised as follows:

(i) The invention relates to a cutting wheel assembly comprising at least two cutting wheels as disclosed in the application on pages 4 - 6 in combination with figures 2A, 2B. Each of the cutting wheels of this assembly having a base wheel made of alloy tool steel, the dimensional accuracy of cut work pieces decreases due to deformation of the base wheel during cutting if, in order to decrease material loss due to cutting, the thickness of each base wheels is reduced.

(ii) Document D2 discloses for a single cutting wheel that the dimensional accuracy of cut work pieces remains acceptable if, in order to decrease material loss, the thickness of the base wheel is reduced, when the base wheel is made of cemented metal carbide instead of alloy tool steel. Document D2 furthermore discloses for certain types of cemented metal carbides values for the Young's modulus, it remains however completely silent on values for the hardness of these cemented metal carbides. Taken into account that for the same type of cemented metal carbides having a specified value with respect to Young's modulus the values for the hardness can differ, depending on the variation of parameters like grain size of the metal carbides, sintering temperature and time, as can be derived from documents D3 and D4, it remains open which values for the hardness are associated for the types of cemented metal carbides referred to in document D2.

(iii) Thus contrary to the decision under appeal it cannot be assumed that, using base wheels made of cemented metal carbides as disclosed in document D2 in a cutting wheel assembly according to the closest prior art, these cemented metal carbides have a value for the Vickers hardness lying in the range defined for the Vickers hardness in claim 1. Consequently the high dimensional accuracy of cut work pieces as given for the examples

of the invention disclosed in the application in suit, which has to be attributed to the high hardness of the cemented metal carbide as defined in claim 1 cannot be obtained for base plates being made of the material as disclosed in document D2 and having reduced thickness.

Reasons for the decision

1. *Disclosure of document D2*

1.1 Document D2 - in the following reference is made to the English translation - discloses an abrasive-bladed cutting wheel with a base wheel including a cemented metal carbide having a Young's modulus in the range of 45000 to 70000 kgf/mm^2.

The use of cemented metal carbide as material for the base plate is disclosed in the portion of D2 relating to the solution (cf. page 1, paragraph [0004]). Specific types of cemented metal carbide, namely WC-90/Co-10%, WC-85/Co-15% and WC-80/Co-20%, are referred to in the description relating to examples 1, 3 and 2 (cf. page 2, paragraph [0014]; page 3, paragraphs [0017] and [0020]). According to these examples the Young's modulus for these three types of cemented metal carbides is 58000 kgf/mm^2, 55000 kgf/mm^2 and 50000 kgf/mm^2, respectively.

In document D2 it is, without referring to particular values, indicated that the hardness of the base wheel made of cemented metal carbide is important in order to

avoid deformation of the base plate, such a deformation having negative influence on the dimensional accuracy of cut pieces (cf. page 2, paragraph [0010]).

Document D2 does not state any value or values for the hardness of the cemented metal carbide referred to.

For the person skilled in the art, however, the hardness as well as Young's modulus are standard physical and material properties, their values in technical standard books and articles reflecting the general technical knowledge.

An example of the general technical knowledge concerning the material properties of cemented metal carbide consisting of tungsten carbide and cobalt is given by table 1 of document D3, which refers to reference 16, "ASM Engineered Materials Reference Book", ASM International, pp. 182, 1989; another example is given by table 25 of D5 (cf. pages 156, 157).

Thus, according to D3 for cemented metal carbide of the types WC-90/Co-10% and WC-80/Co-20%, the values for the Young's modulus and the Vickers hardness are 580 GPa and 490 GPa (corresponding to 58000 kgf/mm^2 and 49000 kgf/mm^2)and 1625 and 1050, respectively. According to D5 for the types of cemented metal carbide WC-90/Co-10%, WC-85/Co-15% and WC-80/Co-20% the values for the Young's modulus are 58500 kg/mm^2, 54000 kg/mm^2 and 50000 kg/mm^2 (kg of table 25 of D5 corresponding to kgf of claim 1), respectively. For the Vickers hardness for these types of cemented metal carbide value ranges are given as 1350 - 1450, 1150 - 1250 and 1050 - 1150, respectively.

Thus the above mentioned tables of documents D3 and D5 show that for the types of cemented metal carbide referred to in D2, namely WC-90/Co-10%, WC-85/Co-15% and WC-80/Co-20%, the values given for the Young's modulus and the Vickers hardness lie within the ranges defined in claim 1 for these material properties.

1.2 The appellant did not dispute this fact but argued that due to the fact that the hardness can, for a given type of cemented metal carbide, still be varied by varying parameters like grain size, sintering temperature and time such that it is only an assumption that the values given in document D3 and D5 for the hardness actually apply also to the types of cemented metal carbide referred to in document D2.

No evidence has been established that, for each type of cemented metal carbide referred to in D2, a variation of parameters like grain size, sintering temperature and time, which e.g. can be considered as causing the variations of values given by D3 and D5, leads to values for Young's modulus and Vickers hardness which lie outside the ranges defined in claim 1.

1.3 The Board considers the disclosure of D2 encompassing for the types of cemented metal carbides explicitly referred to in this document values for material properties like Young's modulus and Vickers hardness to be known from the general technical knowledge given e.g. by documents D3 or D5. The corresponding values known from D3 or D5 are considered to be representative for the particular types of cemented metal carbides referred to and the corresponding types of cemented

metal carbide referred to in document D2 using the same designations as in these documents or the application in suit are - due to the lack of any disclosure on the contrary - likewise considered to be ones having material properties including Young's modulus and Vickers hardness being representative for the types of cemented metal carbides concerned.

2. *Inventive step*

2.1 Closest prior art

As in the examination, the appellant agreed to the closest prior art being the assembly referred to in the application in suit (cf. pages 4 - 6; figures 2A, 2A). According to this prior art an abrasive-bladed cutting wheel assembly as defined in the preamble of claim 1 is known (cf. page 4, paragraph 2; figures 2A, 2B). The base wheels of this known cutting wheel assembly are made of alloy tool steel (page 4, last paragraph).

The cutting wheel assembly according to claim 1 is thus distinguished from the one according to the closest prior art in that each base wheel includes a cemented metal carbide having a Young's modulus in the range from 45000 to 70000 kgf/mm2 and a Vickers hardness Hv in the range from 900 to 2000.

2.2 Problem

According to the application in suit the mechanical strength of the base wheel is insufficient in case very hard material, such as sintered rare earth magnets, has to be cut. Consequently distortion and warping of the

cutting wheel has to be encountered which adversely effects the dimensional accuracy of the work pieces as cut or sliced (cf. the paragraph bridging pages 4 and 5). In case the thickness of the base wheel is reduced to decrease material loss due to cutting (page 5, paragraph 2) scratching and damaging of the base wheel by particles removed during cutting can lead to severe damages of base wheels being made of alloy steel, which can lead likewise to deformation of the base wheel, such as warping and undulation having an adverse effect on the dimensional accuracy of cut work pieces (cf. the paragraph bridging pages 5, 6).

It is thus the problem underlying the application in suit to improve the known abrasive-bladed multiple cutting wheel assembly so that material loss due to cutting is reduced without dimensional accuracy of cut work pieces being adversely effected (cf. page 6, paragraph 2 and the paragraph bridging pages 6, 7).

2.3 Solution

According to the application in suit this problem is solved by an abrasive-bladed cutting wheel assembly as defined by claim 1, whereby each base wheel includes cemented metal carbide having a Young's modulus in the range from 45000 to 70000 kgf/mm^2 and a Vickers hardness Hv in the range from 900 to 2000.

2.4 Obviousness

The same problem as the one underlying the application in suit is also targeted in document D2 but only for a single cutting blade(cf. translation, page 1,

paragraph [0003]). Corresponding to the application in suit the starting point has been a cutting wheel with a base wheel made of alloy tool steel. Deformation of such a base wheel is referred to as disadvantageous due to its negative impact on dimensional accuracy. This is in particular the case when a base plate has small thickness in order to reduce material loss during cutting of hard material like rare earth sintered magnet material (page 1, paragraph [0003]).

The solution disclosed in D2 consists in providing a base wheel made of a different material, namely of cemented metal carbide (cf. page 1, paragraphs [0004], [0005] and [0006]).

As indicated in paragraphs 1.1 and 1.4 above the specific types of cemented metal carbide given in examples 1, 2 and 3 of D2 (cf. pages 2, 3, paragraphs [0014], [0017] and [0020]), namely WC-90/Co-10%, WC-85/Co-15% and WC-80/Co-20% have Young's modulus and Vickers hardness values lying well within the ranges defined for such values in the characterising feature of claim 1.

Starting from the cutting wheel assembly according to the closest prior art with at least two cutting wheels in an attempt to obtain dimensional accuracy, while at the same time material loss is reduced, by making the base wheel thinner, it is an obvious measure for the person skilled in the art to choose the material disclosed as being advantageous for this purpose for a single base wheel in document D2 for each of the base wheels, in order to obtain the advantageous effect as disclosed for one base wheel in D2 for all base wheels.

With respect to combined consideration of the closest prior art, relating to a cutting wheel assembly with a least two cutting wheels, and document D2, disclosing a cutting wheel assembly with only one cutting wheel, the appellant argued that the person skilled in the art would not have considered document D2, since it relates to a cutting wheel assembly with only one cutting wheel, whereas a cutting wheel assembly having at least two cutting wheels has to satisfy more stringent requirements, e.g. with respect to torsional stiffness and stability, resulting from the arrangement of more than one cutting wheel.

While the Board accepts that such requirements are likely to exist it is of the opinion that on the one hand it needs to be considered that claim 1 does not comprise a feature relating to such further requirements.

On the other hand it needs to be taken into account that, despite the fact that in the evaluation of the subject-matter of claim 1 all features need to be considered, the problem underlying the application in suit as well as the features which essentially contribute to the problem being solved relate to the cutting and in particular to the cutting wheel.

In this respect the appellant failed to provide evidence for its argument, that the behaviour of a cutting wheel in the case of a single cutting wheel being provided differs significantly from the situation in which at least two cutting wheels are provided, such that the person skilled in the art would not have

considered prior art relating to only one cutting wheel, as it is the case for document D2, with the closest prior art relating to a cutting wheel assembly comprising at least two cutting wheels.

Further arguments of the appellant in support of claim 1 involving inventive step which are based on a different evaluation of the disclosure of document D2 cannot be followed in view of the disclosure of document D2 evaluated by the Board as indicated in section 1.2 above.

Thus, as indicated above in section 1.2, the appellant has failed to provide evidence for its allegation that by variation of parameters like grain size, sintering temperature and time for given types of cemented metal carbide, like the ones disclosed in document D2, the value for the Vickers hardness can be influenced to such an extent that, instead of values for the Vickers hardness considered to be representative for these types of cemented metal carbides (cf. D3, table 1 and D5, table 25) lying within the value range defined for the Vickers hardness in claim 1, values would be arrived at lying outside the defined range.

The dimensional accuracy being allegedly much higher for the examples according to the application in suit as compared to the dimensional accuracy arrived at for the examples of D2, the appellant concludes that the basis for such differences has to lie in differences concerning the hardness of the cemented metal carbides used in these examples, the Vickers hardness as defined in claim 1 thus being the result of inventive step. As indicated in section 1.3 above the Board cannot follow

this argument since such differences concerning dimensional accuracy can, as far as the same materials are used in these examples, contributed to other factors like the exact composition of the abrasive blade layer, the hardness of the material to be cut and the exact operating conditions under which the cutting has been performed. Such differences are thus no indication that, contrary to the general technical knowledge, the specific types of cemented metal carbide referred to in the examples of the application in suit do have values with respect to the Vickers hardness values lying outside representative values for the type of material concerned, such that claim 1 involves an inventive step.

The abrasive-bladed cutting wheel assembly according to claim 1 thus does not involve an inventive step (Article 56 EPC).

Order

For these reasons it is decided that:

1. The appeal is dismissed.

The Registrar: The Chairman:

G. Nachtigall C. Holtz