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**D E C I S I O N**  
**of 28 September 2004**

**Case Number:** T 0787/01 - 3.2.6

**Application Number:** 94907035.3

**Publication Number:** 0682580

**IPC:** B23B 27/14

**Language of the proceedings:** EN

**Title of invention:**

Cemented carbide with binder phase enriched surface zone and enhanced edge toughness behaviour

**Patentee:**

SANDVIK AKTIEBOLAG

**Opponent:**

KENNAMETAL INC.

**Headword:**

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**Relevant legal provisions:**

EPC Art. 123(2), 84, 83, 114(1), 54(3), 54(2), 56

**Keyword:**

"Clarity (yes)"

"Sufficiency of disclosure (yes)"

"Document late filed in opposition - discussed in the written submission of the parties during the appeal proceedings - admitted in appeal (yes)"

"Novelty (yes)"

"Inventive step (yes)"

**Decisions cited:**

-

**Catchword:**

-



Case Number: T 0787/01 - 3.2.6

**D E C I S I O N**  
of the Technical Board of Appeal 3.2.6  
of 28 September 2004

**Appellant:** KENNAMETAL INC.  
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**Respondent:** SANDVIK AKTIEBOLAG  
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**Representative:** Weber, Roland, Dipl.-Chem.  
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**Decision under appeal:** Interlocutory decision of the Opposition  
Division of the European Patent Office posted  
25 May 2001 concerning maintenance of European  
patent No. 0682580 in amended form.

**Composition of the Board:**

**Chairman:** P. Alting van Geusau  
**Members:** G. Pricolo  
M. B. Tardo-Dino

## Summary of Facts and Submissions

I. The appeal is from the interlocutory decision of the Opposition Division posted on 25 May 2001 concerning the maintenance in amended form of European patent No. 0 682 580, granted in respect of European patent application No. 94907035.3.

In the decision under appeal the Opposition Division considered that the patent in suit as amended in accordance with main request met the requirements of Article 123(2) and (3), 84 and 83 EPC. The Opposition Division decided to disregard the late filed document

D3: WO-A-93/17140,

because it was not more relevant than the prior art already on file, and considered that the claimed subject-matter was novel and also involved an inventive step over the cited prior art. It particularly considered the documents

D1: US-A-4 610 931; and

D2: US-A-4 548 786.

II. The appellant (opponent) lodged an appeal, received at the EPO on 12 July 2001, against this decision and simultaneously paid the appeal fee. The statement setting out the grounds of appeal was received at the EPO on 4 October 2001.

III. In an annex to the summons for oral proceedings pursuant to Article 11(2) Rules of Procedure of the boards of appeal the Board expressed its preliminary opinion that although it would appear that the claims as amended did not introduce subject-matter going beyond the content of the application as filed and that the invention was sufficiently disclosed in the patent in suit, for reasons of clarity it was necessary to specify in the claims that the rounded edges specified in the characterising part were cutting edges of a cutting insert. Furthermore the Board pointed out that it had to be discussed whether the discretionary decision of the Opposition Division to disregard D3 should be reviewed, and that the discussion of novelty and inventive step should in any case include the prior art disclosed by D1 and D2.

IV. Oral proceedings took place on 28 September 2004.

The appellant requested that the decision under appeal be set aside and that the patent be revoked.

The respondent (patentee) requested that the appeal be dismissed and that the patent be maintained on the basis of the amended main request filed during oral proceedings or alternatively on the basis of one of the four auxiliary requests filed with letter dated 11 April 2004.

V. Claims 1 and 3 of the main request read as follows:

"1. Coated cemented carbide cutting insert with improved edge toughness containing WC and cubic phases based on carbide and/or carbonitride in a binder phase based on cobalt and/or nickel with a binder phase

enriched surface zone essentially free of cubic phase and with rounded cutting edges, characterized in that the binder phase content along a line essentially bisecting the cutting edge increases towards the cutting edge at a distance  $<75 \mu\text{m}$  from the outer rounded cutting edge surface, that cubic phase is present along said line and that the insert has a 0.5 to 3  $\mu\text{m}$  thick innermost layer of cubic phase on the surface of the binder phase enriched surface zone except in the cutting edges."

"3. Method of making a coated cemented carbide cutting insert according to claim 1 with improved cutting edge toughness containing WC and cubic phases of carbide and/or carbonitride in a binder phase based on cobalt and/or nickel with a binder phase enriched surface zone comprising a thermal nitrogen treatment and an (a) cutting edge rounding operation after sintering but prior to coating, characterized in that said treatment in two steps is started with a short,  $< 5 \text{ min}$  nucleation treatment at increased nitrogen pressure, 300 to 1000 mbar at a temperature between 1280 and 1450  $^{\circ}\text{C}$  followed by a period of a lower nitrogen pressure of 50 to 300 mbar for 10 to 100 min whereafter the nitrogen gas is maintained to a temperature where the binder phase solidifies at 1265 to 1300  $^{\circ}\text{C}$ ".

VI. In support of its requests the appellant relied essentially on the following submissions:

The application as filed specifically disclosed rounded edges having a radius in the order of 50-100  $\mu\text{m}$ . In contrast thereto, claim 1 referred to rounded edges in general without specifying the radius. As a consequence

claim 1 of the main request infringed Article 84 EPC because it lacked clarity and Article 123(2) EPC because its subject-matter included values of the radius outside the disclosed range of 50-100  $\mu\text{m}$ . Furthermore, the requirements of Article 83 EPC were not met because the invention could not be regarded as sufficiently disclosed for those rounded edges having a radius outside the disclosed range. Moreover the claims did not specify what kind of coating was provided onto the insert, and although a two-step process was essential for the performance of the invention, claim 3 covered embodiments in which the two steps could consist of one single step carried out at a constant temperature and substantially constant pressure of about 300 mbar.

Document D3 should not have been disregarded by the Opposition Division. This document disclosed a method of making a coated cemented carbide cutting insert in which after the sintering stage a treatment of 30 minutes at 1375 °C followed by a continued cooling in nitrogen down to 1200 °C was carried out. Thus, after the sintering stage a two-step treatment was made as in the patent in suit. As shown in Fig. 1 of D3, both cubic phase and binder phase were present in a range of from about 450 to 10  $\mu\text{m}$  from the surface of the insert. Fig. 1 also disclosed that cubic phase was present on the surface of the binder phase enriched surface zone in a thickness of less than 5  $\mu\text{m}$ . As a result of the gradient sintering process of D3, the binder phase content increased towards the surface. Since the edges of a cutting insert formed part of the surface thereof, it was clear that there was an increasing binder phase content towards the surface along any line intersecting

the cutting edges, including a line essentially bisecting the cutting edges. Also, if cubic phase was present in the material underneath the binder phase enriched surface zone essentially free of cubic phase, then cubic phase was inherently also present along said line bisecting the edges. Finally, since conventional edge rounding took place in the edges, part of the cubic phase present on the very surface of the insert was removed. Therefore, D3 was novelty destroying for the subject-matter of claim 1.

Furthermore, the claimed subject-matter lacked an inventive step in the light of the disclosure of D1 and D2. D1 referred to a coated cemented carbide insert in which the binder enriched layer extended into the cutting edge zone. It was clear from the disclosure of Fig. 1 that the binder phase content along a line essentially bisecting the cutting edge increased towards the cutting edge and that cubic phase was present along said line. In order to improve the toughness of the edge, the skilled person would turn to document D2 which disclosed for this purpose to treat the insert at high temperature in nitrogen atmosphere, in particular by means of a process in two-steps. Since D2 further disclosed that by varying the conditions of nitrogen pressure, hold temperature and hold time the depth of the resulting cubic phase depletion as well as the degree and depth of the binder phase enrichment could be affected, the skilled person would choose the appropriate conditions to achieve the desired improvement of edge toughness thus arriving in an obvious manner at the claimed subject-matter.

VII. The respondent essentially argued as follows.

During the sintering stage of the method in accordance with the patent in suit, which was carried out in an argon atmosphere and at a temperature at which the binder phase was in liquid state, carbonitrides present in the initial powder mixture decomposed and nitrogen diffused to the surface of the insert. During the subsequent thermal treatment in accordance with the invention, the diffusion of nitrogen was reversed because the pressure of nitrogen was increased at the surface of the insert. In the first step of the thermal treatment, nucleation of cubic phase on the insert surface was started, and in the second step the cubic phase was allowed to grow. In the zone of the cutting edge, due to the fact that the material of the insert was there delimited by two converging surfaces, the mechanism of diffusion of nitrogen in the material was influenced from two sides and the structure obtained was consequently different from that obtained in zones at a distance from the cutting edge. The two steps method in accordance with the patent in suit allowed to obtain a structure in which the binder phase content along a line essentially bisecting the cutting edge increased towards the cutting edge. This was in contrast with the structure in a cutting edge zone obtained with conventional sintering methods, where the content of cubic phase along said line was increased with a corresponding decrease in binder phase content.

The application as filed was not restricted to any specific values for the rounded edge. The range of 50 to 100  $\mu\text{m}$  was disclosed in connection with the discussion of the prior art and was not presented as



essential for the performance of the invention underlying the patent in suit. Also the kind of coating of the cutting insert was not presented as an essential feature for the performance of the invention. The skilled person would not have any difficulties in selecting specific coatings and edge radius values from those generally known. Furthermore, claim 3 made it clear that the thermal nitrogen treatment effectively comprised two distinct steps because it specified a lower nitrogen pressure in the second step.

D3, which was state of the art according to Article 54(3) EPC, was only concerned with binder phase enrichment near the surface zone of a cemented carbide insert. It was silent about the binder phase or cubic phase concentrations at the edge zones of a cutting insert. Moreover, the thermal nitrogen treatment disclosed in D3, consisting in holding the insert for 30 minutes at 1375 °C in a nitrogen atmosphere of 300 mbar and thereafter cooling down to 1200 °C did not result in an increase of the binder phase content along a line bisecting the cutting edge in the direction towards the cutting edge. In fact, D3 disclosed the application of this thermal nitrogen treatment to a specific cutting insert composition for which the nitrogen pressure of 300 mbar was insufficient for providing sufficient nucleation of cubic phase on the surface of the insert such as to avoid further diffusion of nitrogen into the inside of the insert during the subsequent stage in which cubic phase was allowed to grow. Thus, with the thermal nitrogen treatment of D3 an enrichment of cubic phase was obtained, rather than of binder phase, along a line essentially bisecting the cutting edge in the direction

towards the cutting edge. Also D1 and D2 were silent about the binder phase or cubic phase contents at the cutting edge zones of a cutting insert. From Fig. 1 of D1 it could only be derived that a binder phase enriched layer and a binder phase depleted layer were present along a line essentially bisecting the cutting edge, not that the binder phase content increased towards the cutting edge. Moreover, the disclosure of D2 that the conditions of nitrogen pressure, hold temperature, and hold time of the nitrogen thermal treatment after sintering would affect the depth of the resulting cubic phase depletion as well as the degree and depth of the binder phase enrichment did not suggest a nitrogen thermal treatment in the sense of the patent in suit. Therefore, the claimed subject-matter was novel and also involved an inventive step in the light of the available prior art.

## **Reasons for the Decision**

1. The appeal is admissible.
2. *Amendments (Article 123 EPC)*
  - 2.1 Claim 1 is based on the disclosure of claims 1, 3 and 4 of the application as filed. It additionally includes the features that the insert is a cutting insert having cutting edges and that the cutting edge surfaces are rounded. Basis for the insertion of these features is found on page 1, lines 10 to 15 and on page 5, lines 13 and 14 of the application as filed.

2.2 In the introductory part of the application as filed relating to the background art, it is disclosed that the edges of a cutting insert must "have a certain radius of the order of 50-100  $\mu\text{m}$  or less in order to be useful" (page 2, lines 11 to 14 of the application as filed). This disclosure implies that satisfactory cutting performances in metal machining are obtained when the insert is provided with a cutting edge radius of 50-100  $\mu\text{m}$ . However, this disclosure cannot be regarded as implying that a cutting edge radius of 50-100  $\mu\text{m}$  is essential for the performance of the invention, i.e. for the solution of the problem underlying the application as filed of improving the edge toughness (see page 2, line 31). Therefore, the absence of a specific range of values for the radius in claim 1 does not result in the patent containing subject-matter extending beyond the content of the application as filed (Article 123(2) EPC).

2.3 Claim 3 is based on the disclosure of claims 5, 3 and 4 and the above-mentioned passages in the description of the application as filed.

Claim 2 corresponds to claim 2 of the application as filed.

2.4 The description of the patent in suit is adapted to be consistent with the claims as amended.

2.5 Therefore, since the amendments also result in a limitation of the extent of protection, the requirements of Article 123(2) and (3) EPC are met.

3. *Clarity (Article 84 EPC)*

The Board is satisfied that the claims are sufficiently clear for the skilled reader to unambiguously identify the matter for which protection is sought.

The appellant submits that claim 1 is not clear because it does not define that the cutting edge has a radius of 50-100  $\mu\text{m}$ . However, as explained above, the value of the cutting edge radius is not an essential feature of the claimed invention and therefore the claim cannot be considered to lack clarity on this basis.

4. *Sufficiency of disclosure (Article 83 EPC)*

4.1 Having regard to the definition of the process for manufacturing a cutting insert given in claim 3, the detailed explanation of how to carry out the various process steps and the examples of materials usable in making the cutting insert given in the description of the patent in suit (column 3, lines 6 to 17 and 50 to 55; example 1 on column 4), the Board comes to the conclusion that the invention is sufficiently disclosed within the meaning of Article 83 EPC.

4.2 The appellant submits that the invention is not sufficiently disclosed for those rounded edges having a radius outside the disclosed range of 50-100  $\mu\text{m}$ . Since the value of the radius is not an essential feature of the invention, and in fact the problem underlying the patent in suit to increase the edge toughness (column 2, lines 10,11) is solved independently from the specific value of the cutting edge radius and thus also for radiuses outside the range of 50-100  $\mu\text{m}$ , there is no

insufficient disclosure on this basis. In any case the radius must be such that the edge functions as a cutting edge and in this respect sufficient information for the different materials to be cut is generally available to the skilled person.

Nor can the appellant's objection concerning the absence in the claim of a specification of the kind of coating justify a lack of sufficient disclosure. The knowledge of wear resistant coatings is part of the general knowledge of the skilled person in the technical field of cutting inserts. Examples of suitable coatings are given in the patent in suit (column 3, line 53). Moreover, the kind of coating does not have any appreciable influence on the underlying metallurgical structure, in particular in the distribution of binder phase and cubic phase obtained as a result of the sintering and subsequent thermal nitrogen treatment.

Finally, the appellant objected insufficient disclosure on the basis that claim 3 is not restricted to the presence, in the thermal nitrogen treatment, of two distinct steps. This view cannot be followed because the claim specifically recites that in the second step a nitrogen pressure is applied which is lower than that of the first step.

5. *Novelty*

- 5.1 Document D3 was disregarded by the Opposition Division pursuant to Article 114(2) EPC because not submitted in due time. The Opposition Division based its decision on the fact that D3 was not more relevant than the

documents already on file. Without intending to criticize the manner in which the first instance department exercised its discretion, but, having regard to the fact that not only the appellant but also the respondent, in both written and oral proceedings, have so extensively discussed the content of document D3 that if it were to be disregarded the decision would not reflect the course of these appeal proceedings, and further having regard to the fact that the admission of D3 is not to the detriment of the respondent, the Board decides to consider D3 in detail in the present proceedings pursuant to Article 114(1) EPC.

- 5.2 D3, which is comprised in the state of the art under Article 54(3) and (4) EPC in conjunction with Article 158(1) and (2) EPC, discloses a method of manufacturing a coated cemented carbide cutting insert in which a heat treatment in nitrogen atmosphere is carried out after the sintering step. In accordance with the general teaching of D3 the heat treatment is carried out at a pressure of 40-400 mbar and at a temperature of 1280-1430°C for 5-100 min (see claim 7). Example 1 specifically refers to a heat treatment comprising a first stage at 1375 °C and 300 mbar nitrogen pressure for 30 minutes followed by a second stage at 1200 °C. As a result of the sintering and heat treatment there is obtained an insert having a layer of binder phase enriched zone essentially free from cubic phase and below that a zone slightly depleted of binder phase (page 7, lines 3 to 6), with particles of cubic phase on its very surface (page 7, lines 9 to 11). D3, however, apart from stating that part of the cubic phase present on the surface is removed as a result of conventional edge rounding (page 7, lines 12 to 14), is

silent about the metallurgical structure obtained in the edge zones, in particular along a line essentially bisecting the edge. The information contained in D3 about the structure of the cutting insert, in particular having regard to Figure 1 referred to by the appellant and the above-mentioned passages of the description (page 7, lines 2 to 14), refers to the structure of the insert at a distance from the surface (see e.g. page 3, line 34 to page 4, line 2) but is not specific to the edge zone. As pointed out by the respondent, the metallurgical structure obtained in the edge zone as a result of the sintering process and the subsequent heat treatment cannot be expected to be identical to that obtained at a distance from the edge zone because the edge zone is located between two converging surfaces of the cutting insert. In particular, the diffusion of nitrogen within the material of the cutting edge zone is under the influence of the nitrogen pressure at both the converging surfaces delimiting said cutting edge zone. In contrast thereto, the diffusion of nitrogen within the structure of the cutting insert at a distance from the cutting edge zone is essentially under the influence of nitrogen pressure on one surface only of the cutting insert, the other surfaces being sufficiently far away from the latter. Since the final structure of the cutting insert, in particular the formation of cubic phase, depends on the manner in which nitrogen diffused, the structure obtained in the cutting edge zone differs from that obtained at a distance from the cutting edge.

Therefore D3 does not explicitly disclose the feature of claim 1 that the binder phase content along a line essentially bisecting the cutting edge increases towards the cutting edge at a distance  $<75 \mu\text{m}$  from the outer rounded cutting edge surface.

Neither can it be concluded that this feature is implicitly disclosed by D3, as an inevitable result of the manufacturing method: in the absence of any evidence to the contrary, the Board is satisfied that, in accordance with the respondent's submissions, the thermal nitrogen treatment disclosed in D3, consisting in holding the insert for 30 minutes at  $1375 \text{ }^\circ\text{C}$  in a nitrogen atmosphere of 300 mbar and thereafter cooling down to  $1200 \text{ }^\circ\text{C}$  provides, for the specific cutting insert composition of example 1 (pages 6 and 7), an amount of diffusion of nitrogen into the inside of the insert such that, rather than an enrichment of binder phase, an enrichment of cubic phase is obtained along a line essentially bisecting the cutting edge in the direction towards the cutting edge.

- 5.3 Document D1 discloses a cutting insert in accordance with the preamble of claim 1, namely a coated cemented carbide cutting insert containing WC and cubic phases based on carbide and/or carbonitride in a binder phase based on cobalt and/or nickel (column 3, lines 17 to 25) with a binder phase enriched surface zone essentially free of cubic phase (claim 1) and with rounded cutting edges (column 6, lines 35, 36).

D1 fails to give any information about the metallurgical structure along a line essentially bisecting the cutting edge. Figure 1 of D1 referred to



by the appellant shows a cross section through a cutting insert comprising a binder enriched layer 14 and a binder depleted layer 16 over the bulk 18 of the insert body 12. Although a line which bisects the cutting edge of the insert of Fig. 1 passes through the binder enriched layer 14 and the binder depleted layer 16, the figure is a schematic drawing of the insert and thus cannot be regarded as giving a clear and unambiguous disclosure of the metallurgical structure existing along said bisecting line at a distance  $<75 \mu\text{m}$  from the outer rounded cutting edge surface.

Similarly, document D2 fails to give any information about the metallurgical structure along a line essentially bisecting the cutting edge.

In fact, as stated in the patent in suit in connection with the acknowledgement of the prior art known from D1 and D2 (see column 1, lines 23, 28 and 39 to 45), and in the absence of any evidence to the contrary, in the cutting inserts in accordance with D1 and D2 the content of cubic phase in a corner area is increased relative to that of an essentially plane surface with a corresponding decrease in binder phase content.

5.4 Therefore, the subject-matter of claim 1 is novel over the available prior art.

6. *Inventive step*

6.1 Since D3 is state of the art under Article 54(3) EPC, pursuant to Article 56 EPC it is not considered in deciding on inventive step.

6.2 Starting from a cutting insert as known from D1, which undisputedly represents the closest prior art, the problem underlying the patent in suit consists in improving the edge toughness of the cutting insert (see column 2, lines 2 to 12 of the patent in suit).

This problem is solved by means of the combination of features of claim 1, in particular by means of the feature that the binder phase content along a line essentially bisecting the cutting edge increases towards the cutting edge at a distance  $<75 \mu\text{m}$  from the outer rounded cutting edge surface, because the toughness of a portion of the insert is directly related to the content of binder phase.

6.3 D1 discloses that a significant improvement in the edge strength of the insert is obtained by the provision of a sufficiently thick binder enriched layer (column 4, line 67 to column 5, line 5). However neither D1 nor D2 recognize that the specific metallurgical structure obtained in the localized cutting edge zone is different from that obtained at a distance therefrom and that this has a substantial effect on the edge toughness. The prior art thus fails to give any indications pointing towards the above-mentioned feature of claim 1 concerning the binder phase content along a line essentially bisecting the cutting edge. Nor does the prior art suggest any measures with which this feature could be obtained. D2 discloses that by varying the conditions of nitrogen pressure, hold temperature and hold time during the sintering process (column 3, line 54 to column 4, line 6) the depth of the resulting cubic phase depletion as well as the degree and depth of the cobalt (i.e. binder phase)

enrichment can be affected. However, this disclosure does not include any indications in respect of what process conditions would provide an increase of binder phase in the cutting edge zone.

6.4 Therefore, the proposed solution to the above mentioned problem is not rendered obvious by the available prior art. It follows that the subject-matter of claim 1 of the main request is found to involve an inventive step.

7. Since the method of claim 3 of the main request directly results in a coated cemented carbide cutting insert according to claim 1, its subject-matter is likewise novel and involves an inventive step.

7.1 Therefore, independent claims 1 and 3 together with the dependent claim 2 according to the main request filed during the oral proceedings, the description and the drawings of the patent as maintained by the Opposition Division, form a suitable basis for maintenance of the patent in amended form.

## 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 following documents:

**claims:** 1 to 3 filed during the oral proceedings of 28 September 2004;

**description:** columns 1 to 6 of the patent as maintained by the Opposition Division;

**drawings:** Figures 1 to 5 of the patent as maintained by the Opposition Division.

The Registrar:

The Chairman:

M. Patin

P. Alting van Geusau