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**Datasheet for the decision
of 14 February 2017**

Case Number: T 1173/12 - 3.2.08

Application Number: 00125694.0

Publication Number: 1122010

IPC: B23B27/14, B23B27/00, B23C5/20

Language of the proceedings: EN

Title of invention:
Cutting tool of polycrystalline hard sintered material

Patent Proprietor:
Sumitomo Electric Industries, Ltd.

Opponent:
Sandvik Intellectual Property AB

Headword:

Relevant legal provisions:
EPC Art. 56

Keyword:

Decisions cited:

Catchword:



Beschwerdekammern
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European Patent Office
D-80298 MUNICH
GERMANY
Tel. +49 (0) 89 2399-0
Fax +49 (0) 89 2399-4465

Case Number: T 1173/12 - 3.2.08

D E C I S I O N
of Technical Board of Appeal 3.2.08
of 14 February 2017

Appellant: Sumitomo Electric Industries, Ltd.
(Patent Proprietor) 5-33, Kitahama 4-chome,
Chuo-ku
Osaka-shi,
Osaka (JP)

Representative: Grünecker Patent- und Rechtsanwälte
PartG mbB
Leopoldstraße 4
80802 München (DE)

Appellant: Sandvik Intellectual Property AB
(Opponent) 811 81 Sandviken (SE)

Representative: Weber, Roland
WSL Patentanwälte Partnerschaft mbB
Postfach 6145
65051 Wiesbaden (DE)

Decision under appeal: **Interlocutory decision of the Opposition**
Division of the European Patent Office posted on
23 March 2012 concerning maintenance of the
European Patent No. 1122010 in amended form.

Composition of the Board:

Chairwoman P. Acton
Members: C. Herberhold
I. Beckedorf

Summary of Facts and Submissions

- I. By its decision posted on 23 March 2012 the Opposition Division decided that European patent No. 1 122 010 in amended form according to the 5th auxiliary request then on file and the invention to which it related met the requirements of the EPC.
- II. Both parties to the opposition proceedings lodged duly filed and reasoned appeals against that decision.
- III. Oral proceedings before the Board of Appeal were held on 14 February 2017. For the course taken by the proceedings, in particular the issues discussed with the parties, reference is made to the minutes of the oral proceedings.
- IV. At the end of the oral proceedings, the parties' requests were as follows:

Appellant I (patent proprietor) requested that the decision under appeal be set aside and that the patent be maintained as granted or, in the alternative, that the patent be maintained in amended form on the basis of one of the sets of claims filed with letter of 13 January 2017 as auxiliary requests 1 to 9, and that the appeal of appellant II be dismissed.

Appellant II (opponent) requested that the decision under appeal be set aside and that European patent No. 1 122 010 be revoked and that the appeal of appellant I be dismissed.

V. Claim 1 of the main request (corresponding to claim 1 of the patent as granted) reads as follows:

"**(F1)** A cutting tool of a polycrystalline hard sintered material, comprising a cutting edge, the tool being **characterized in that**

(F2) said cutting edge comprises the polycrystalline hard sintered material containing 20 vol % or more CBN,

(F3) a ridge (15) of said cutting edge is formed with a curve having a radius of curvature in cross section in a range of 5 μm to 30 μm ,

(F4) a flank (12) and a rake face (13) or negative land (14) of the cutting tool are smoothly continued at said curve,

(F5) and a surface roughness of said ridge (15) has a range of 0.1 μm to 1.0 μm corresponding to an average roughness Rz of a ten point system."

The feature identifiers F1-F5 have been added by the Board.

The auxiliary requests play no part in this decision.

VI. The following documents played a role for the present decision:

D2: Marc Turco et al., "Finish grinding of PCD and PCBN cutting tools", Proceedings of The Finishing of Advanced Ceramics and Classes Symposium at the 101st Annual Meeting of The American Ceramic Society, Indianapolis, Indiana, April 25-28, 1999;

D3: Alfred F. Scheider, "Precision Edge Radius Grinding of Diamond Cutting Tools and Inserts", Conference Superabrasives, June 11-13, 1991, Chicago, Illinois;

D4: Textbook, Whitney, "Ceramic Cutting Tools Materials, Development, and Performance", 1994;

D6: Gaser Joe, "Edge and Surface Honing on Various Shaped PCD and CBN Inserts", Manufacturing Conference, Chicago, Illinois, 1992;

D7: US 5,215,415;

D8: N.I. Al'khimenko et al., "Grinding of tools having CBN-tipped inserts", Stanki i Instrument, Vol. 54, Issue 10, 1983, pp.24;

D10: Textbook, Stephenson and Agapiou, "Metal cutting theory and practice", 1996;

D12: WO 98/28464.

VII. The essential arguments of appellant II can be summarised as follows:

Inventive step

Document D4 was the closest prior art. Taking into account the knowledge of the skilled person as documented in documents D3, D6, D10 and D12, it disclosed a cutting tool of polycrystalline cubic boron nitride (PCBN) having all the characteristics F1-F4 as claimed. D4 did however not disclose feature F5, i.e. a surface roughness of the ridge of the cutting edge having a range of 0.1 μm to 1.0 μm , corresponding to an average roughness Rz of a ten-point system. The technical effect of the smooth cutting edge was a smoother surface of the resulting workpiece, the problem thus being to provide a cutting tool capable of

achieving a high-quality, i.e. very low roughness, mirror-like machined workpiece surface.

In order to solve said technical problem, the person skilled in the art would consider the teaching of any of documents D2, D7 or D8, which all suggested a surface roughness of the ridge of the cutting edge within the claimed range, see D2, Table V; D7, column 5, line 47 - column 6, line 39; D8, table on page 82. In particular D2, Table V, last column showed the excellent average workpiece roughness obtainable by the disclosed low-roughness high-quality edge. Even if D2 disclosed in Figure 8 a grinding process in which the workpiece was at rest, it was well known to the skilled person to adequately move the workpiece if a rounded edge was present or to be created. Also D7 mentions in column 2, lines 44-46, that the low-roughness upper surface - which included the cutting edge - would make chipping, welding or fusing on the edge unlikely, i.e. it improved the surface roughness of the resulting surface. Thus the person skilled in art would be incited to provide the honed cutting edge of the cutting insert disclosed in D4, page 282, first paragraph, with a smooth edge as defined in feature F5, thereby arriving at a cutting tool as claimed.

Therefore, the subject-matter of claim 1 of the main request did not involve an inventive step.

VIII. The essential arguments of appellant I can be summarised as follows:

Inventive step

Document D4 was indeed the closest prior art, but it did not disclose any of features F2-F5. These features in combination, in particular the excellent surface

roughness of the (curved) ridge and its smooth continuation into the adjacent surfaces resulted in very good surface roughness of the workpiece, thus solving the technical problem as defined in paragraph [0007] of the patent.

Even if - in order to solve said problem - the skilled person consulted D2, that document did not disclose a rounded edge but referred to grinding the sides of a sharp edge, see Figure 6. This process created low roughness on the side surfaces, but was not capable of creating a rounded edge with a low roughness and with smooth transition into the adjacent surfaces. In this context, also the favourable roughness values shown in Table V, last two columns - if they were at all given in μ inches, which was heavily contested - were only obtained in the context of a sharp edge, not a rounded one. Moreover, as could be seen from D2, Figure 8, the workpiece was to be held stationary during the grinding process. There was no disclosure of moving the workpiece in order to conserve or even re-create a rounded cutting edge. Applying the teaching of D2 to the cutting tool disclosed in D4 would thus not result in a cutting tool as claimed.

Analogous argumentation applied to D8, which equally referred to the creation of sharp cutting edges by grinding wheels, which could only create polished flat surfaces, but not a low-roughness rounded cutting edge with smooth transition into the adjacent surfaces.

D7, on the other hand, did not relate to the problem posed, but aimed at increasing the durability of the tool. Furthermore, it only referred to polishing the side surfaces of a sharp cutting edge. It could thus

not suggest, nor did it disclose, providing a low-roughness rounded cutting edge.

Thus, applying the teaching of any of documents D2, D7 or D8 to the cutting tool according to D4 did not lead the skilled person to the subject-matter of claim 1 of the main request, which consequently involved an inventive step.

Reasons for the Decision

1. Main request - Article 56 EPC
- 1.1 Both parties agree that D4 is the closest prior art.
- 1.2 There is further agreement that D4 does at least not disclose feature F5, i.e. a surface roughness of the ridge of the cutting edge having a range of 0.1 μm to 1.0 μm , corresponding to an average roughness Rz of a ten-point system.
- 1.3 A cutting tool with the claimed roughness of the ridge of the cutting edge is able "to make the surface roughness of the cut face 1.6 μm or less" (patent, paragraph [0007] and Table 2).
- 1.4 For the sake of argument, it is assumed that the skilled person, aiming in particular at providing a cutting tool for achieving improved / superior roughness of a finished machined surface, would consider the teaching of any of documents D2, D7 or D8.

1.5 D4 + D2

1.5.1 D2 discloses that cutting tools with high-quality edge preparation show superior tool performance (D2, page 59, "Machining PCD and PCBN Tools"), in particular with respect to average cutting time and average workpiece Ra (see Table V). In favour of appellant II it is assumed that the skilled person would derive from Table V that a high-quality edge in the sense of D2 is provided with a surface roughness of its ridge in the range of 0.1 μm to 1.0 μm corresponding to an average roughness Rz of a ten point system.

1.5.2 However, the high-quality edge disclosed in D2 is a "sharp edge" (see D2, Figure 6), i.e. it is not formed with a curve having a radius of curvature in cross-section in a range of 5 μm to 30 μm .

There is no reason why the skilled person would consider the roughness of the edge to be a parameter which in itself - i.e. separate from the ridge geometry - is decisive for improved tool performance and which, when applied to a ridge of a different, rounded geometry, would still result in the superior tool performance documented in Table V. In other words, the skilled person would consider the roughness of the ridge and the ridge geometry to be a complete solution for the superior-performance cutting edge of D2. However, providing the cutting tool of D4 with such a "complete solution" ridge would result in a cutting tool without the claimed radius of curvature in cross-section in a range of 5 μm to 30 μm , and thus in a cutting tool not falling under the scope of claim 1.

1.5.3 Furthermore, even if the skilled person was incited by D2 to provide the cutting tool of D4 which has a

chamfered cutting edge and a small honed radius of 10 μm to 20 μm (see D4, page 282, first paragraph) with a roughness according to D2, Table V, it remains open how such a cutting tool would be obtained. D2 discloses particular grinding processes for finishing the PCBN cutting tools with particular grinding wheel and machining systems (page 61, "Process" - page 65; Figure 8). These machining systems - whether they use a conventional infeed-controlled process or a force-controlled process (page 60, "Machine") - do not create the rounded cutting edge claimed: as can be seen in Figure 8, during the grinding process of D2 the workpiece is at rest while the oscillating grinding wheel is fed. Thus, even if the process is started on a cutting tool with a rounded and smoothly continued cutting edge (such as - according to appellant II - disclosed in D4), the rounded edge and its smooth continuation into the adjacent surfaces is destroyed by the grinding process.

1.5.4 Appellant II has pointed out that the person skilled in the art would overcome said problem by applying their general knowledge and appropriately moving the tool relative to the grinding wheel such as to conserve the edge rounding. This would however require an extremely precisely controlled movement of the tool with respect to the grinding wheel, capable of appropriately smoothing the cutting edge surface while not substantially altering the pre-existing geometry. There is no indication for such a process in D2, and its development would exceed the routine adaptations to the disclosed process which can be expected from the person skilled in the art.

1.5.5 According to the impugned decision, point 3.2.3.4 of the reasons, "it would be possible to apply a specific

roughness to the rounded ridge of a cutting tool by means of for example a grinding wheel (or any other grinding / polishing method) without removing the radius". However, firstly, this view does not overcome the problem discussed in point 1.5.2 above. Secondly, as discussed in paragraph [0014] of the patent, appellant I had found that grinding alone with a diamond grinder having small grains of around #3000 to #14000 could be used to form a ridge of the cutting edge with small surface roughness, but it was difficult to smoothly continue the rake face and the flank of the tool to the ridge of the cutting edge. Thus the Opposition Division's view - which is not backed up by any documentary evidence - is at odds with the experimental experience reported in the patent.

Furthermore, the patent discloses how to achieve the claimed tool in paragraphs [0015] and [0016]: "The cutting tool of the polycrystalline hard sintered body of the invention is edged by grinding the flank and the rake face of the tool by means of the diamond grinder of grain diameter being around #600 to #3000, and subsequently, a coated rotary brush with diamond free abrasive grain of around #1500 to #3000, so as to polish an edged vicinity", with "samples of various kinds of radius of curvature in cross section being prepared and investigated by the above mentioned polishing method". Thus, to obtain the inventive ridge, grinding must be followed by subsequent specific polishing. In contrast, there is no disclosure of such a post-grinding polishing step in D2.

Only hindsight can suggest start off with a rounded edge cutting tool as disclosed in D4, then destroying said rounded cutting edge by the grinding process of D2 in order to provide a particular low roughness of the

edge, and then restoring the former rounding by polishing - instead of being satisfied with the intermediately obtained sharp-edge cutting tool which had the very high-quality edge disclosed in D2.

Even if the skilled person started off with a cutting tool with a sharp edge, there is no indication in D2 to provide a rounded edge.

1.5.6 Consequently, the combination of the teachings of documents D4 and D2 cannot lead the skilled person in an obvious way to the subject-matter of claim 1.

1.6 D4 + D7

As for D2, the edge disclosed in D7 is a sharp edge (see column 2, lines 48-51 and column 6, lines 35-39) and is thus not formed with a curve having a radius of curvature in cross-section in a range of 5 μm to 30 μm .

Thus, as discussed in point 1.5.2 above, there is no reason why the skilled person would apply the surface roughness disclosed in D7 to a cutting-edge ridge of a different geometry, instead of providing the cutting edge according to D7 as a combined solution (i.e. without the rounding), which is disclosed as having the advantage of a reduced cutting resistance (column 2, lines 47-51).

1.7 D4 + D8

D8 discloses the making of CBN tools with diamond grinding wheels. There is no disclosure of a rounded cutting edge. Thus, even if one assumes that the Rz values indicated in the table were on the ridge (and not on the rake or flank surface), the situation is at

best analogous to the combination of D4 with D2. The reasoning in points 1.5.1-1.5.6 above therefore applies in analogy.

- 1.8 Consequently, even applying the teaching of any of documents D2, D7 or D8 to the cutting tool of D4, the person skilled in the art would not in an obvious way arrive at feature F5 as claimed. It can thus be left open whether or not D4 - taking into account the knowledge of the skilled person documented in documents D3, D6, D10 and D12 - does indeed disclose features F2-F4. To conclude, the invention as defined in claim 1 of the main request involves an inventive step.

2. Having thus established that the subject-matter of claim 1 of the patent as granted involves an inventive step, and in view of the absence of any other objection to the patent as granted, the Board finds that the appeal of appellant I directed to maintenance of the patent as granted is allowable and that the appeal of appellant II directed to revocation of the patent is to be dismissed.

Order

For these reasons it is decided that:

1. The decision under appeal is set aside.
2. The patent is maintained as granted.
3. The appeal of the opponent is dismissed.

The Registrar:

The Chairwoman:



C. Moser

P. Acton

Decision electronically authenticated