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**Datasheet for the decision
of 31 January 2012**

Case Number: T 0319/10 - 3.2.08

Application Number: 99933443.6

Publication Number: 1105546

IPC: C22C 29/08

Language of the proceedings: EN

Title of invention:
Method of making cemented carbide

Patent Proprietor:
SANDVIK AKTIEBOLAG

Opponent:
Kennametal Widia & Co.KG

Headword:
-

Relevant legal provisions:
EPC Art. 56

Keyword:
"Inventive step (no)"

Decisions cited:
-

Catchword:
-



Case Number: T 0319/10 - 3.2.08

D E C I S I O N
of the Technical Board of Appeal 3.2.08
of 31 January 2012

Appellant: Kennametal Widia & Co.KG
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Respondent: SANDVIK AKTIEBOLAG
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Decision under appeal: Decision of the Opposition Division of the
European Patent Office posted 30 December 2009
rejecting the opposition filed against European
patent No. 1105546 pursuant to Article 101(2),
2nd sentence, EPC.

Composition of the Board:

Chairman: T. Kriner
Members: R. Ries
A. Pignatelli

Summary of Facts and Submissions

- I. By its decision posted on 30 December 2009 the opposition division rejected the opposition against European patent No. 1 105 546.
- II. The appellant (opponent) lodged an appeal against this decision on 16 February 2010, paying the appeal fee on the same day. The statement setting out the grounds of appeal was received on 15 April 2010.
- III. In an official communication, the Board gave its provisional view on the case, in particular with respect to the documents

E1: WO-A-98/03690;

E8: M. Willert-Porada et al.: "Einsatz von Mikrowellen zum Sintern pulvermetallurgischer Produkte", Teil 2, Metall, 51. Jahrgang, Nr. 1-2/97, 1997, pages 57 to 65.

- IV. Oral proceedings took place before the Board on 31 January 2012. The following requests were made:

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

The respondent (patent proprietor) requested that the appeal be dismissed or, alternatively, that the patent be maintained according to one of the auxiliary requests 1 or 2, filed on 28 December 2011.

V. Independent claim 1 of the patent as granted reads as follows:

"Method of making a cemented carbide by mixing powder of WC and possibly other powders forming hard constituents and binder phase and pressing agent, drying preferably by spray drying, pressing and sintering, wherein

- the mixing is wet mixing with no change in grain size or grain size distribution of the hard constituent powders
- the WC grains are coated with binder metal and deagglomerated prior to the mixing and
- sintering is made by microwave sintering at 1325-1410°C with a holding time of 5 - 15 min."

Claim 1 of the first auxiliary request reads as follows (the features which have been added to claim 1 as granted are written in bold):

"Method of making a cemented carbide by ... microwave sintering at 1325-1410°C with a holding time of 5 to 15 min **and**

- **the WC-powder has a narrow grain size distribution**
 $d_{\max} - d_{\min} < 2 \mu\text{m}.$ "

Claim 1 of the second auxiliary request reads as follows (the features which have been added to claim 1 as granted are written in bold):

"Method of making a cemented carbide by ... microwave sintering at 1325-1410°C with a holding time of 5 to 15 min **and**

- **the WC-powder has a bimodal grain size distribution."**

VI. The appellant's arguments can be summarized as follows:

Document E1 as the closest prior art referred to a method of making a fully dense cemented carbide body starting from WC particles coated with a binder metal and having a bimodal grain size distribution. The known method comprised the steps of wet mixing the two different WC-powders with deagglomerated powders of other carbides, binder metal and pressing agent, followed by spray drying, pressing and sintering (E1, page 3, lines 10 to 22). It was essential according to E1, page 3, line 34 to page 4, line 2 that the mixing took place without milling so that there was no change in grain size or grain size distribution as a result of the mixing. Prior to mixing, the WC grains were deagglomerated before and after being coated with the binder metal (E1, page 3, lines 22 to 24). However, the known method used standard (or conventional) sintering by heating in a furnace rather than microwave sintering (MWS) as in the claimed method.

Although the patent specification failed to mention any specific problem that was to be solved by the claimed method, the objective problem when starting from document E1 was seen in preserving as possible in the cemented carbide as much the original grain size distribution, in preventing grain growth and obtaining less pronounced binder phase pools, compared to corresponding powder mixtures sintered according to standard practice (the patent specification, paragraph [0004]). Given that only two alternative methods for

sintering WC-Co hard metals existed, namely conventional furnace sintering and MWS, the skilled person would consider document E8, which compared both methods and addressed the advantages, including lower sintering temperatures and shorter holding times, higher hardness and very fine grain distribution, which are associated with microwave sintered WC-Co hard metals (E8, page 61, paragraph entitled "WC-Co-Hartmetalle). The example given in E8, Figure 24 disclosing MWS of WC-Co cermets at 1350°C/10 min fell within the ranges set out in claim 1 of the patent as granted and prompted the skilled person to treat the WC-Co hard metal in that way.

Contrary to the respondent's position, which was based on Figures 21 and 22 and the accompanying text on page 61, column 3 of E8, this document did not teach adherence to a sintering temperature of at most 1300°C or lower. Figures 21 and 22 only showed that a very high density and a closed porosity of 1% was achieved at 1300°C but they did not exclude using higher sintering temperatures, as was confirmed in Figure 24 of E8. In the light of E1 and E8, the method set out in claim 1 of the main and second auxiliary requests was therefore obvious for the person skilled in the art and, consequently, lacked an inventive step.

The feature set out in claim 1 of the first auxiliary request merely defined a narrow grain size distribution which was, however, always aimed at when producing WC-Co hard metals. Therefore, this feature did not involve an inventive step either.

VII. The respondent's arguments are summarized as follows:

Novelty of the method set out in claim 1 as granted was not disputed by the appellant. When starting from the technical teaching of document E1 as the closest prior art disclosing the most common features with claim 1 of the patent, the object underlying the present invention resided in providing a method for making a cemented carbide having a fully dense structure while preserving the original narrow WC-grain size distribution and a very uniform binder distribution. This problem was solved by combining the features known from E1 with MWS within a very specific temperature range of 1325 to 1410° and a very short holding time within 5 to 15 minutes.

Document E1 already disclosed a suitable sintering method for the described process, namely standard sintering practice, which meant conventional heating in a sintering furnace, and brought about good results, as mentioned in E1, page 4, last line to page 5, line 2. Putting into practice the process of E1, the skilled person thus had no reason to look for an alternative sintering method referred to for instance in E8.

Even if the skilled person had considered document E8 since it compared conventional sintering and MWS, this document did not disclose anything about the metallurgical pre-treatment including wet mixing and pre-coating of the WC grains set out in the claimed method. Moreover, on page 61, right column, document E8 stated by referring to Figures 21 and 22 that the major portion of the densification took place at much lower temperatures than those applied in conventional

sintering. As is evident from E8, Figures 21 and 22, closing of the porosity and densification by MWS was already completed at temperatures much below 1300°C compared to conventional sintering. This went to show that E8 recommended MWS of WC-Co hard metals at temperatures below 1300°C, which meant that the eutectic temperature necessary for dissolving at least in part the surface of the WC grains by the liquid cobalt binder phase was not reached. Contrary thereto, the temperature range between 1325 and 1450°C required in the claimed process guaranteed that the eutectic temperature actually was reached. Hence, E8 was teaching away from the claimed method.

The appellant also referred to Figure 24 of E8 showing an example of MWS at 1350°C/10 min. However, this Figure could not be taken as a recommendation to apply temperatures higher than 1300°C. As described in the accompanying text referring to Figure 24 in E8 on page 61, the microstructure of the cobalt phase achieved by these parameters is comparable to that obtained by the prior art as regards the grain form and branching of the binder phase. By contrast, the claimed method sought to achieve a more uniform cobalt binder distribution than the prior art, but not a comparable structure.

Last but not least, examples 1 and 2 given in the patent surprisingly exhibited a lower Vickers hardness and consequently had a better toughness after MWS, which was in sharp contrast to E8 describing that a higher hardness in MWS cermets compared with conventionally furnace sintered cermets was determined.

As to claim 1 of the first auxiliary request, the narrow grain size distribution $d_{\max} - d_{\min} < 2 \mu\text{m}$ resulted in a more uniform fine microstructure of the cermet. Neither E1 nor E8 gave any hint to select such a grain size distribution.

Hence, the claimed method set out in claim 1 as granted (main request) or of the first and second auxiliary requests was not obvious from the combined teaching of E1 and E8. The subject matter of claim 1 of all requests therefore also involved an inventive step.

Reasons for the Decision

1. The appeal is admissible.
2. Novelty; the closest prior art
 - 2.1 It was common ground to the parties and the Board that document E1 qualified as representing the closest prior art. Like the patent at issue, document E1 is concerned with a method of making a cemented carbide body by wet mixing without milling WC-powders of two different grain sizes (i.e. without changing the grain size and the bimodal grain size distribution of WC hard constituent powders) with deagglomerated powders of other carbides and a binder metal, spray drying, pressing and sintering the body according to standard practice (E1, claims 9 and 10; page 2, second paragraph; example 1 A, page 4, line 24 to page 5, line 2). Prior to mixing, the WC grains are deagglomerated before and after being coated with the binder metal (E1, page 3, lines 22 to 24 and claim 10).

The method set out in claim 1 of the main and second auxiliary requests differs from E1 in that the sintering step is carried out by microwave sintering at 1325 to 1410°C with a holding time of 5 to 15 minutes.

The subject matter of claim 1 of the main request is therefore novel over the technical disclosure of document E1.

3. The problem to be solved

Starting from the teaching of document E1, the objective problem underlying the patent at issue resides in providing a sintering technique which results in a narrower grain size distribution, less pronounced binder phase pools, shorter sintering times and lower temperatures with essentially no grain growth compared to corresponding powder mixtures sintered according to standard practice.

The solution to this problem is microwave sintering the pressed WC-mixture at 1325 to 1410°C with a holding time of 5 to 15 minutes.

4. Inventive step:

However, for the following reasons, the distinguishing technical features from E1, selected to solve the identified problem and set out in claim 1 of all requests, are obvious to the skilled person in the light of the technical disclosure of document E8.

4.1 Main and second auxiliary requests:

Firstly, document E8 compares the mechanical properties of WC-Co hard metals obtained by standard sintering practice in a heating furnace with those obtained by MWS. It was not disputed by the respondent at the oral proceedings that only these two sintering methods are at the skilled person's disposal for producing hard metals (E8, page 61, column 3, paragraph: WC-Co-Hartmetalle and Figures 21 to 24). Hence, MWS was the only alternative to conventional sintering in a furnace.

Secondly, compared with conventional sintering, MWS is said in document E8 to allow lower sintering temperatures and much shorter holding times, which result in a very fine grain structure. Put the other way, the appropriate selection of the sinter parameters essentially attenuates or even avoids undesirable grain growth (E8, page 61, right column, lines 50 to 52; page 63, column 2, first full paragraph). Reference is made in this context to the patent specification paragraph [0008], which confirms this finding. The technical advantages attributed to MWS in E8 comply with the objects addressed in paragraph [0004] of the patent specification. Contrary to the respondent's position, the person skilled in the art, looking for technical assistance to solve the identified problem, would therefore be prompted to consider document E8.

The respondent's interpretation based on Figures 21 and 22 that E8 recommends sintering temperatures below 1300°C is not convincing. Both Figures and the accompanying passage on page 61 only teach that MWS at 1300°C achieves a closed porosity of 1%. Porosity is,

however, only one physical property amongst others also aimed at. There is no suggestion anywhere in document E8 that MWS of WC-Co hard metals should be restricted to a temperature below 1300°C. To the contrary, the specific working example disclosed in E8, Figure 24 comparing conventional sintering and MWS of WC-25%Co explicitly mentions MWS at 1350°C/10 min, which exactly corresponds to the microwave sintering parameters required for the claimed process. Another MWS example sintered at 1380°C/10 min which also meets the claimed ranges is found in document E8, Figure 25. The skilled person putting into practice the teaching of E8 would therefore be led to use the process parameters disclosed in Figure 24 or 25, all the more so since he or she is taught on page 61 that, compared to conventional sintering, the microwave sintered hard metal exhibits a finer grained microstructure and a better cutting performance.

The respondent's argument that, compared to conventionally sintered inserts, examples 1 and 2 of the patent exhibited a lower Vickers hardness has no bearing on the matter. Nothing is found anywhere in the patent specification implying that, compared to conventionally sintered hard metals, a lower hardness is aimed at by MWS, and the specification is silent on the question whether a lower Vickers hardness actually is to be rated as an advantage or not.

Hence the process set out in claim 1 of the main and the second auxiliary requests does not involve an inventive step.

4.2 First auxiliary request:

The method set out in claim 1 of the first auxiliary request further requires selecting a WC-powder having a narrow grain size distribution of $d_{\max} - d_{\min} < 2 \mu\text{m}$. The patent specification remains silent as to why such an extremely narrow distribution for the WC grains is preferred and what technical advantage is associated with this selection (patent specification, [0012]).

At the oral proceedings, the respondent argued that the narrow grain size distribution was chosen to provide very fine grained microstructure in the sintered insert. Such a fine grain microstructure is, however, always aimed at for WC-Co hard metals since it generally provides a less heterogeneous structure, an improved hardness and a better cutting performance. One of the main reasons for carrying out MWS is to obtain a finer grain size in the sintered insert and, as a consequence thereof, a better hardness (E8, page 61, penultimate paragraph). Hence the additional technical feature in claim 1 of the first auxiliary request does not involve an inventive step.

5. Conclusion

The Board is therefore convinced that the implementation of the general technical knowledge described in E8 in the method of producing a WC-Co hard metal disclosed in document E1 leads to the subject matter of present claim 1 of all requests without inventive step.

Order

For these reasons it is decided that:

1. The decision under appeal is set aside.
2. The patent is revoked.

The Registrar:

The Chairman:

V. Commare

T. Kriner