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File No.: T 0901/90 - 3.3.2
Application No.: 84 303 230.1
Publication No.: 0 125 912
Classification: C04B 35/00
Title of invention: Method of producing ceramic parts

D E C I S I O N
of 23 September 1993

Applicant:

Proprietor of the patent: NGK INSULATORS, LTD.

Opponent: (01) MTU Motoren- und Turbinen-Union München
GmbH
(02) Stora Feldmühle AG Patentabteilung

Headword: Ceramic parts/NGK

EPC: Art. 54, 56

Keyword: "Novelty (yes) - no anticipation of process features in the correct sequence" - "Inventive step (yes) - non-obvious modification"

Headnote
Catchwords



Case Number: T 0901/90 - 3.3.2

D E C I S I O N
of the Technical Board of Appeal 3.3.2
of 23 September 1993

Appellant: MTU Motoren-und Turbinen-Union München GmbH
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Representative: -

Appellant: Stora Feldmühle AG
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Representative: -

Respondent: NGK INSULATORS, LTD.
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Representative: Myerscough, Philip Boyd
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Decision under appeal: **Decision of the Opposition Division of the
European Patent Office dated 19 September 1990
rejecting the opposition filed against European
patent No. 0 125 912 pursuant to Article 102(2)
EPC.**

Composition of the Board:

Chairman: P.A.M. Lançon
Members: I.A. Holliday
E.M.C. Holtz

Summary of Facts and Submissions

I. European patent No. 0 125 912 was granted on the basis of six claims contained in European patent application No. 84 303 230.1. Claim 1 as granted read as follows:

"1. A method of producing ceramic parts by mixing a ceramic powder or metal powder with a moulding additive, injection moulding the mixture to form a green body, removing the moulding additive to yield a degreased body and firing the degreased body to sinter the same, characterized in that a green pre-form is processed to a substantially final configuration."

II. Two oppositions were filed against the grant of the patent.

Of the documents cited during the opposition proceedings, the following are relevant to the present decision.

- (1) US-A-4 004 934
- (3) SPK Oxide Ceramics (Commercial Literature of 02)
- (4) DE-C- 680 250

III. The Opposition Division rejected the oppositions, taking the view that the subject-matter of the patent in suit was novel. Document (4) was considered to be the closest state of the art. There is a suggestion in (4) of treating a green body form by injection moulding prior to the degreasing step. However, the Opposition Division considered this to amount to a finishing treatment not to a substantial machining of the green body. Since one of the alleged advantages of injection moulding was that

it was possible to obtain ceramic bodies of complicated shape in a one-step process, the Opposition Division considered that it would not have been obvious to subject such an injection moulded body to substantial reshaping.

IV. Both Opponents, hereinafter referred to as Appellant (1) and Appellant (2) respectively, lodged appeals against the decision of the Opposition Division.

Appellant (1) listed the various steps in the method of Claim 1 and argued that each of the said six steps was disclosed in document (1); the sources of the alleged disclosure were indicated. The Appellant considered that Claim 1 lacked novelty in the light of this disclosure.

Appellant (1) also contested the Opposition Division's view that the treatment disclosed in document (4) amounted to nothing more than a surface treatment or finishing of the green ceramic body.

Appellant (2) also argued that the subject-matter of Claim 1 lacked novelty over either document (1) or document (4) and furthermore that a combination of documents (1) and (4) deprived the subject-matter of inventive step.

The Appellant referred to a further document:

(5) Randolph, Injection moulded ceramics, Materials in Design Engineering, August 1961, pages 10 to 12.

In particular, the Appellant drew attention to the machining of a green ceramic body in (5) in which the more volatile organic additives had been removed leaving a residue of resin prior to machining. It was argued

that the process was analogous to that of the patent in suit which thus lacked inventive step.

- V. The Respondent contested the Appellants' arguments. Although each of the steps of the process of the patent in suit might well have been individually mentioned in document (1), they were not disclosed in association. The Respondent referred in particular to the worked examples.

As far as inventive step was concerned, the Respondent's main point was that injection moulding was known to produce complicated shapes without the necessity for further processing. Accordingly, it would not have been obvious to produce a ceramic body by injection moulding and then subject it to a further machining step. It was argued that the Opposition Division had been right in differentiating between a surface or finishing treatment, such as deburring, which was disclosed in the prior art and the major reshaping which forms part of the process of the patent in suit.

With the response to the appeal, received in the EPO on 17 July 1991, the Respondent filed an amended Claim 1. The said claim is the same as the granted Claim 1 with "before it is subjected to the degreasing process" added at the end of the claim after the word "configuration".

The Respondent made a conditional request for oral proceedings.

- VI. The Appellants request that the contested decision be set aside and the patent be revoked.

The Respondent requests that the appeal be dismissed and that a patent be maintained on the basis of Claim 1

received in the EPO on 17 July 1991 and Claims 2 to 6 as granted.

Reasons for the Decision

1. The appeals are admissible.
2. The basis for the amendment to Claim 1 is to be found in column 4, lines 2 and 3 of the printed patent specification (page 7, lines 10 and 11 of the originally filed documents). Amendments of a cosmetic nature are not normally allowed during opposition procedure (cf. T 127/85, on EPO 1989, 271). However, since the sequence of process step had apparently been misunderstood by one of the Appellants, the Board has decided to allow the amendment. Since this is a clarifying amendment which in no way extends the scope of Claim 1, the requirements of Articles 123(2) and 123(3) are satisfied.
3. Appellant (2) has referred to an additional document (5) in a letter received in the EPO on 13 September 1991. The Appellant offered no explanation as to why this document was filed so late in the proceedings. However, the Board took advantage of the written procedure to consider its relevance. Having regard to the fact that the Board considers it to be the closest state of the art and also to the conclusion reached in the appeal, the document was exceptionally admitted to the proceedings.
4. Both appellants have argued a lack of novelty, relying in particular on documents (1) and (4).
 - 4.1 Appellant (1) listed the various steps in the claimed method in an erroneous sequence, as a consequence of

which the claim has been amended (see point 2 above). The corrected sequence reads as follows:

mixing a ceramic (or metal) powder with a moulding additive
injection moulding the mixture to form a green body
shaping to a preform
processing to a substantially final configuration
degreasing, i.e removing the moulding additive by limited heating
sintering the degreased body.

- 4.2 Document (1), which relates to sintered silicon carbide, discloses a variety of methods which might be used to obtain the green body. In column 5, lines 21 ff, the specification first mentions pressing, including isostatic pressing, as a suitable means for obtaining the green body. This is immediately followed by a reference to possible machining of the green body to obtain more complex shapes (column 5, lines 38 to 39). Slip casting is then mentioned as a possible way of obtaining a green ceramic body (column 5, lines 47 to 56). Finally references occur in the same sentence, to extrusion or injection moulding (column 5, lines 57 to 59). Various mould additives, such as those employed in the method of the patent in suit, are mentioned (column 5, lines 59 to 65). Degreasing or "prefiring" is mentioned in column 6, lines 6 to 9, followed by a reference to "green machining" (column 6, lines 10 to 12) but in this context it seems to mean machining **after** removal of the mould additives. In the worked examples of (1). Examples I to IV and VI to XI use a pressing process to form green bodies and in Example V slip casting is used to form a ceramic crucible. None of the examples employs injection moulding.

4.2.1 Thus document (1), although mentioning each of the above features, does not contain a clear and unambiguous disclosure of the steps set out above in the correct sequence. Even though separate items belonging to different embodiments may be described in the same document, it is not permissible to combine them unless the document specifically suggests such combination (cf. T 305/87, OJ EPO 1991, 429; Reasons, point 5.3). Novelty over the disclosure of (1) must accordingly be acknowledged.

4.3 Document (4) relates to a process for the manufacture of ceramic objects, especially the ceramic parts of sparking plugs. A preferred starting material is corundum which contains as mould additives a mixture of synthetic shellac, soft asphalt and wood tar oil (cf. Claim 4). It is stated on page 2, lines 71 to 73 that the additives are present in order to obtain a mass which is capable of being injection moulded and also sufficiently strong to withstand mechanical working before firing. It is to be noted that the German word used in this context is "überarbeiten". The Board is satisfied that, having regard to the relatively simpler configuration of the articles to be moulded in comparison for example to the rotors described in the patent in suit, the treatment is in the nature of finishing or deburring. In contradistinction DE-A-2 449 662 which is the German equivalent of document (1), uses the word "bearbeiten" at the top of page 10 to convey the meaning of milling or machining.

4.3.1 The individual sequence of steps of Claim 1 of the patent in suit are not to be found in document (4) which accordingly does not prejudice the novelty thereof.

4.4 The other prior art documents are all more remote than (1) and (4). In particular the "green machining"

referred to on page 12 of (5) takes place only after a considerable proportion of the moulding additive has been removed. this amounts to much more than "drying" referred to in the patent in suit (cf. column 3, lines 37 to 41).

5. The Board considers document (5) to be the closest state of the art. The article acknowledges that injection moulding has been previously used to produce articles of simpler shape, such as sparking plug insulators (cf. document (4)), and refers to a variety of ceramics, e.g. titania, zirconia, spinel and barium titanate which have been injection moulded (page 11, paragraph bridging left hand and centre columns). Document (5) also refers in the centre column of page 11 to mixtures of (unspecified) plastics and oil used as moulding additives. The process is claimed to produce quite complex mouldings, e.g. thread guides, nose cones and electronic components, with only minimal finishing operations (page 10, opening paragraph). According to page 11 (left-hand column) it is possible to prepare articles of complex shape having moulded surfaces which are smoother than those obtained by extruding or by machining. The article also refers to possible machining prior to the final firing (page 12, penultimate paragraph) but such machining is carried out when most of the mould additive has been removed leaving "a small amount of resin" to impart "green strength". No details are given of such machining or why it might be deemed necessary in the light of the satisfactory properties noted above.

- 5.1 In relation to (5), the problem to be solved is to develop an improved injection moulding process for ceramics which is capable of producing complex parts such as rotors for turbines.

5.2 The problem is solved by employing the process of Claim 1 of the patent in suit. Especially having regard to the comparative tests relating to quantities of cracked final products, the Board is satisfied that the problem has indeed been solved, the amount of waste being significantly reduced

6. It remains to consider whether or not the method of Claim 1 satisfies the requirements of Article 56 EPC in respect of inventive step.

6.1 As indicated above, the essential difference between the method of Claim 1 and that disclosed in (5) lies in the processing to a final configuration before being subjected to the degreasing process. It is admitted that, as pointed out by Appellant (2), the penultimate paragraph on page 12 of (5) refers to a possible "green machining". However, there is no suggestion of first preparing a preform of substantially simpler configuration to the desired end product. Moreover, as pointed out above in relation to novelty, most of the moulding additive would have been removed prior to such possible treatment. The green body retains only a "small amount of resin" to give it sufficient green strength for "handling, grinding or machining".

6.1.1 One of the advantages of the process of the patent in suit is that after the green body has been machined to its final configuration, the chips of raw material removed during machining still contain the moulding additive and can be reused by mixing with fresh raw materials (column 4, lines 17 to 23). This would not be the case if most of the moulding additive had already been baked out as described in (5). The Board is accordingly convinced that document (5) alone does not give any hint which would render obvious the method claimed in the patent in suit.

6.2 As mentioned in detail above in relation to novelty, document (1) contains a hint that a green body "may be machined by grinding, milling etc" (column 5, lines 38 to 39). This occurs immediately after pressing has been described as the first possible means for producing the desired ceramic articles and before other methods such as slip casting, extrusion or injection moulding are mentioned. Having regard to the worked examples of (1), it is clear that pressing is the preferred method for producing the green ceramic bodies; injection moulding receives nothing more than a brief mention. Accordingly, document (1) contains no hint that any advantages might be derived from preparing a green body by injection moulding and subjecting the said green body to further machining prior to the degreasing step.

6.3 Document (4), which dates from 1939, concerns a process for producing, by injection moulding, ceramic bodies of relatively simple configuration especially insulators for sparking plugs which is stated to overcome the disadvantages of the casting process hitherto used to manufacture such ceramic objects (page 2, lines 10 to 20). By adding organic additives to the raw materials, it was possible to process the materials in an injection moulding apparatus known in the plastics industry. Although it is mentioned that the green bodies might be subjected to mechanical treatment (page 2, lines 73 to 76), the accent is on a rapid direct method for preparing relatively simpler ceramic bodies. Having regard to the use of the German verb "überarbeiten", the Board is of the opinion that a surface treatment or finishing process is intended not a major reworking of the moulded green body.

6.4 Document (3) is a commercial prospectus published by Appellant (2) in 1980. It discloses methods for producing ceramic objects by alternative processes, the

flow diagram on page 6 being of particular interest. When employing injection moulding (or extrusion), the raw materials are "plastified" (i.e mould additives are mixed therewith) before moulding. After moulding, the green bodies are deburred (i.e surface treatment) prior to inspection and sintering (firing). Other alternative means for preparing ceramic bodies are hot pressing and cold pressing. According to the flow diagram, only the bodies prepared by the cold pressing are subjected to green machining prior to sintering. Thus the skilled person could not derive from document (3) that it might be advantageous to first prepare a preform by injection moulding and then subject the said green preform to substantial machining and reshaping prior to degreasing and sintering.

- 6.5 To summarise: although the prior art may have shown that the person skilled in the art could have subjected an injection moulded ceramic body to machining prior to the degreasing step, there is not the slightest hint that he would have done so in the expectation of some advantage (cf. T 2/83, OJ EPO 1984, 265). An inventive step can accordingly be recognised.

Order

For these reasons, it is decided that:

1. The Appeals are dismissed
2. The case is remitted to the first instance with an order to maintain the patent in accordance with the Respondent's request set out in VII above and the description as granted.

The Registrar:

The Chairman:

P. Martorana

P. Lançon