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D E C I S I O N
of 21 December 1999

Case Number: T 0682/97 - 3.2.4

Application Number: 91303206.6

Publication Number: 0452125

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Language of the proceedings: EN

Title of invention:
Heater and catalytic converter

Patentee:
NGK INSULATORS, LTD.

Opponent:
Emitec Gesellschaft für Emmissionstechnologie mbH

Headword:
-

Relevant legal provisions:
EPC Art. 56
EPC R. 67

Keyword:
"Inventive step - (yes)"
"Reimbursement of appeal fee - (no)"

Decisions cited:
T 0405/94

Catchword:
-



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Boards of Appeal

Chambres de recours

Case Number: T 0682/97

D E C I S I O N
of the Technical Board of Appeal 3.2.4
of 21 December 1999

Appellant:
(Proprietor of the patent) NGK INSULATORS, LTD.
2-56 Suda-cho
Mizuho-ku
Nagoya-shi
Aichi-ken 467 (JP)

Representative:
Stoner, Gerard Patrick
MEWBURN ELLIS
York House
23 Kingsway
GB-London WC2B 6HP (GB)

Cross-appellant:
(Opponent) Emitec Gesellschaft für
Emissionstechnologie mbH
Hauptstraße 150
D-53797 Lohmar (DE)

Representative:
Kahlhöfer, Hermann, Dipl.-Phys.
Patent- und Rechtsanwälte
Bardehle, Pagenberg, Dost, Altenburg
Geissler, Isenbruck
Uerdinger Str. 5
D-40474 Düsseldorf (DE)

Decision under appeal: Interlocutory decision of the Opposition Division
of the European Patent Office posted
17 April 1997 concerning maintenance of European
patent No. 0 452 125 in amended form.

Composition of the Board:

Chairman: C. A. J. Andries

Members: H. A. Berger

C. Holtz

Summary of Facts and Submissions

I. The interlocutory decision of the opposition division was dispatched on 17 April 1997 to maintain the European patent No. 0 452 125 in amended form.

On 25 June 1997 the appellant (patentee) filed an appeal against this decision and simultaneously paid the appeal fee. The statement of grounds of appeal was received on 26 August 1997.

On 24 June 1997 the cross-appellant (opponent) filed an appeal against the independent claims 11 and 14 of the maintained version of the patent, and simultaneously paid the appeal fee. The statement of grounds of appeal was received on 27 August 1997.

II. Opposition was filed against the patent as a whole and based on Article 100(a) and (b) EPC. The following prior art documents were cited during the opposition proceedings:

D1: WO-A-89/10471
D2: EP-B-0 049 489
D3: US-A-3 983 283
D4: EP-B-0 245 737
D5: EP-A-0 152 560
D6: EP-B-0 121 174
D7: SU-A-1 254 596

III. Oral proceedings were held on 21 December 1999, during which the appellant submitted a new set of claims, a revised description and a set of drawings adapted to the maintained claims.

IV. The independent claims 1, 12 and 15 read as follows:

Claim 1:

"A resistance heating element comprising an electrically conductive honeycomb structure (10) having partition walls defining a large number of parallel passages for fluid flow extending in an axial direction and at least two electrodes (11) on said honeycomb structure for passing electric current through the structure, wherein current flow for electrical resistance heating of said honeycomb structure (10) in use of the heater passes through the partition walls in general directions parallel to the faces of the partition walls,

characterised

in that said partition walls defining said parallel passages are planar and in that there is at least one slit (12) in said honeycomb structure which is open for axial fluid flow, said slit (12) extending through at least part of the axial length of the structure (10) parallel to said axial direction thereof and crossing the planes of a plurality of said planar partition walls."

Claim 12:

"A method of making a resistance heater having a honeycomb structure (10) which is electrically conductive and has a large number of parallel passages for axial fluid flow defined by partition walls having a general regular pattern throughout the structure

(10), said heater having spaced electrodes (11) for passing electric current through said honeycomb structure, and wherein current flow for electrical resistance heating of said honeycomb structure (10) in use of the heater passes through the partition walls in general directions parallel to the faces of the partition walls,

said method being characterised

in that the honeycomb structure (10) is a monolith and in that the method includes the step of adjusting the electrical resistance characteristic of the structure (10) by providing it with a local incorporated structural non-uniformity or non-uniformities (12, 14, 15) of said regular pattern in a predetermined manner, said structural non-uniformity or non-uniformities comprising:

- (i) a slit or slits (12) cut into the honeycomb structure and extending in a direction for a distance corresponding to a multiple of the dimension of said passages in said direction;
- (ii) a slit or slits (15) interrupting substantially isolated partition walls in the structure; or
- (iii) variations (14) in the partition wall axial length over the honeycomb structure."

Claim 15

"A resistance heater having a honeycomb structure (10) which is electrically conductive and has a large number

of parallel passages for axial fluid flow defined by partition walls having a general regular pattern throughout the structure (10), said heater having spaced electrodes (11) for passing electric current through said honeycomb structure, and wherein current flow for electrical resistance heating of said honeycomb structure (10) in use of the heater passes through the partition walls in general directions parallel to the faces of the partition walls,

characterised in that

the honeycomb structure (10) is a monolith and has a local structural non-uniformity or non-uniformities (12, 14, 15) of said regular pattern incorporated in the structure in a predetermined manner, so as to determine the electrical resistance characteristic of the honeycomb structure, said structural non-uniformity or non-uniformities comprising:

- (i) a slit or slits (12) cut into the honeycomb structure and extending for a distance in a direction corresponding to a multiple of the dimension of said passages in said direction;
- (ii) a slit or slits (15) interrupting substantially isolated partition walls in the structure; or
- (iii) variations (14) in the partition wall axial length over the honeycomb structure."

V. The appellant (patentee) explained the heating element of claim 1 and stated that the honeycomb structure therein is an integral body having a large number of

passages partitioned by walls, as it is unequivocally defined on page 5, lines 15 and 16 of the granted patent. He further pointed out that the slit or slits in said honeycomb structure cross the planes of a plurality of the partition walls and are open for axial fluid flow.

With regard to claims 12 and 15 the appellant explained the meaning of a "monolith", which is a one piece uniform material constitution. The typical foil type metal honeycomb structure therefore is not a monolith in the meaning of claims 12 and 15.

With regard to novelty the appellant argued that the heating element of document D1, which discloses the most relevant state of the art, is not provided with slits in the honeycomb body which cross the planes of partition walls and which are open for axial fluid flow. In the heating element of document D1 insulating layers extend along the walls of the honeycomb structure and are not open for fluid flow. Furthermore, the walls of the honeycomb structure are not planar. Therefore, the heating element of claim 1 is novel with regard to the prior art. Since document D1 does not disclose a monolith and the other cited prior art documents are further away from the subject-matter of the patent, the appellant considers also the heater of claim 15 and the method of making such a heater as defined in claim 12 to be novel.

The appellant further argued that the heating element of claim 1, the method of making a resistance heater according to claim 12 and the resistance heater of claim 15 involve an inventive step, since in document

D1 no hint is given to provide a slit or slits in the honeycomb structure crossing the planes of a plurality of the planar partition walls as defined in claim 1, or to form the honeycomb structure as a monolith as stated in claims 12 and 15. Documents D3 and D6 which describe honeycomb structures with slits therein do not deal with electrical resistance heating and therefore are not relevant.

The appellant also requested reimbursement of the appeal fee and argued that he had no opportunity to respond to the reason given in the decision under appeal for not allowing the main request, namely that the invention was obvious in respect of Figure 11 of document D1. Because of two communications before the oral proceedings which were both positive towards the patentee and since the arguments of the opposition division during the oral proceedings with regard to inventive step were only based on Figure 5 of document D1, it was all the more surprising that the main reason against patentability in the decision of the opposition division was instead based on Figure 11 of document D1.

VI. The cross-appellant (opponent) argued that the heating element of claim 1 is not new having regard to document D1, in particular to claim 1 thereof in which it is clearly stated that the honeycomb structure is electrically divided by slits and/or electrically insulated layers with regard to the square section and/or the axial length. Although the embodiments shown in the drawings, particularly in Figures 5 to 8, are provided with electrically insulating layers, it is clearly proposed in claim 1 as an alternative to provide slits instead of layers for electrically

adjusting the resistance of the honeycomb structure and these slits are inside the honeycomb structure like the insulating layers (see Figure 8) and are thus open for axial fluid flow. The cross-appellant mentioned in this respect also claim 11 of document D1 and maintained that it discloses the provision of ceramic pieces, which set an open passage between the adjacent partition walls. The slits or slots also cross a plurality of partition walls as can be seen from Figure 11 of document D1, which shows an embodiment with slits interrupting the honeycomb structure for adjusting its electrical resistance. Furthermore, in document D1 (page 2, lines 5 to 10) there is a clear relation to document D2 which discloses a honeycomb structure with planar partition walls. Because of this clear relation to document D2 the structure described therein is also part of the disclosure of document D1 and the honeycomb structure of document D1 therefore also comprises the version with planar partition walls. In the opinion of the cross-appellant the heating element of claim 1 therefore is not new.

The cross-appellant further alleged that even if the heating element of claim 1 were new it certainly would not involve an inventive step having regard to document D1 in which document D6 is cited (page 2, line 9 of document D1) as a possibility for a honeycomb structure. According to document D6 slits are cut into the partition walls of the honeycomb structure crossing the planes of a plurality of the partition walls and opening its passages for axial fluid flow. A similar structure with slits therein is described in document D3. The cross-appellant alleged that therefore the skilled person would not be prejudiced against openings

in the structure walls of an honeycomb structure and since in document D1 a clear hint is given (see claim 1 of document D1) for adjusting electrical resistance in the structure by slits, the skilled person would use the idea of forming slits in the honeycomb structure as proposed in document D6 also for adjusting the electrical resistance, and this all the more because in Figure 11 of document D1 an embodiment is shown with slits between the structures of the heater crossing the partition walls of these structures.

With regard to the honeycomb structure with planar partition walls the cross-appellant argued that this structure is commonly known, and for instance disclosed in documents D2 or D5. The selection of such a structure for a heating element, which has nothing to do with the adjustment of the electrical resistance, lies within the normal ability of the skilled person.

The heating element of claim 1 therefore is not inventive in the opinion of the cross-appellant.

The cross-appellant further maintained with regard to claims 12 and 15 of the impugned patent that document D1 gives a clear hint to the use of a honeycomb structure produced by metal powder, i.e. to a monolith, and drew the board's attention to page 6, lines 7 to 9 of document D1. Therefore, the skilled person would consider to provide also in the honeycomb structure of a monolith a slit or slits for adjusting the electrical resistance of the structure as proposed in claim 1 of document D1. With regard to the alternative iii of claims 12 and 15 as maintained during the oral proceedings before the board (i.e. alternative iv of

granted claims 12 and 15), concerning variations in the partition wall axial length over the honeycomb structure, the cross-appellant argued that the embodiment of Figure 11 of document D1 already discloses the adaption of the length of the structures to the necessary resistance and that therefore this alternative iii is also not inventive.

VII. *Requests*

The appellant/cross-respondent (patentee) requested: that the decision under appeal be set aside and that the patent be maintained on the basis of the following:

Claims: 1 to 16,

Description: pages 2 to 8

Figures: 1 to 5, 6a to 6c, 7a, 7b, and 9 to 13,

all as submitted in the oral proceedings on 21 December 1999;

and that the appeal fee be reimbursed.

The cross-appellant/respondent (opponent) requested that the decision under appeal be set aside and that claims 12 and 15 of the patent as maintained by the first instance as well as claim 1 of the patentee's request as submitted during the oral proceedings before the board be refused.

Reasons for the Decision

1. The appeal is admissible.
2. *Allowability of the amendments*
 - 2.1 Claims 12 and 15 were arrived by deleting the alternative iii of granted claims 12 and 15, i.e. the feature "variations in the partition wall thickness or the cell density of the honeycomb structure". This amendment which limits the protection conferred by the granted claims 12 and 15 does not contravene Article 123 EPC.
 - 2.2 The description and the drawings were adapted to the amendment of claims 12 and 15, i.e. the alternative iii of granted claims 12 and 15 was also deleted in the description and the drawings (the granted Figures 8a to 8c and the parts of the description thereto were cancelled). These amendments also do not contravene Article 123 EPC.
3. *Novelty*
 - 3.1 None of the cited prior art documents discloses a resistance heating element with all the features of claim 1 or a method for making a resistance heater with all the features of claim 12 or a resistance heater with all the features of claim 15. The heating element of claim 1, the method of claim 12 and the heater of claim 15, therefore are novel in the meaning of Article 54 EPC.

3.2 The novelty of the heating element of claim 1 was attacked by the cross-appellant solely on the basis of document D1. However, document D1 discloses a honeycomb structure produced by flat and corrugated metal sheets placed alternately one upon the other, and therefore does not disclose a honeycomb structure in which the partition walls defining the parallel passages are planar as defined in claim 1. The cross-appellant alleged that document D2 is part of the disclosure of document D1 since it is cited therein. However, on page 2, lines 6 to 10 indicated by the cross-appellant in this respect, it is only stated in general terms that there are in the prior art different variations of honeycomb structures known as a metallic carrier, wherein under other citations document D2 is cited. It is not stated that these honeycomb structures of the cited prior art documents are used in the heater of document D1. The heating element of claim 1 therefore is already new by the feature concerning the planar partition walls.

Furthermore, it should be emphasized that in the embodiments according to document D1 no slits crossing the planes of a plurality of said planar partition walls are present **in** said honeycomb structures.

4. *Closest prior art*

Document D1 is the only cited prior art document which deals with the adjustment of the electrical resistance in a honeycomb structure of an electrical heater and is therefore taken as the starting point in the evaluation of inventive step.

5. *Problem and solution*

5.1 Problem

5.1.1 Starting from document D1 the technical problem underlying the invention of claims 1 and 15 is to create a resistance heating element in which problems are eliminated which arise from the presence of an insulating layer, i.e. due to differential thermal expansion of the metal and the insulation.

5.1.2 The problem underlying the invention according to claim 12 is the creation of a method which allows the production of a heater of claim 15.

5.2 Solution

5.2.1 The technical problem indicated above is solved according to claim 1 by the at least one slit in the honeycomb structure which is open for axial flow, and which extends through at least part of the axial length of the structure parallel to the axial direction thereof and crossing the planes of a plurality of the partition walls.

5.2.2 The embodiments of claim 15 (i), (ii) and (iii) are fabricated according to the method of claim 12. By cutting the slits into the monolith according to feature (i) of claim 12, the production of the heater is simplified. Furthermore, the slits according to features (i) and (ii) of the heater of claim 15 and the variation of the partition wall length over the honeycomb structure according to feature (iii) allow the adjustment of the electric resistance of the

honeycomb structure without the use of insulating layers.

6. *Inventive step*

6.1 Claim 1

6.1.1 The resistance heating element described in document D1 comprises an electrically conductive honeycomb structure (claim 1 of document D1) having partition walls defining a number of parallel passages for fluid flow extending in an axial direction and at least two electrodes (Figures 5, 6, 8, 10 and 11) on said honeycomb structure for passing electric current through the structure, wherein current flow for electrical resistance heating of said honeycomb structure in use of the heater passes through the partition walls in general directions parallel to the faces of the partition walls.

6.1.2 The heating element of claim 1 differs therefrom in that the partition walls defining the parallel passages are planar and in that there is at least one slit in said honeycomb structure which is open for axial fluid flow, said slit extending through at least part of the axial length of the structure parallel to said axial direction thereof and crossing the planes of a plurality of said planar partition walls.

6.1.3 The use of planar partition walls cannot be considered by the board as having any inventive merit, since they are commonly known and used.

6.1.4 The embodiment of Figure 11 of document D1 discloses a

heater with several, spatially separated, honeycomb bodies which are positioned in a row and which are separated from each other by spaces. These spaces however are not provided **in** the honeycomb structure and do not extend through at least part of the axial length of the structure parallel to the axial direction thereof. The separate bodies of this arrangement are shown in Figure 10 of document D1 according to which insulating layers are provided inside the honeycomb structure and extend in axial length parallel to the axial direction of the structure along partition walls of the honeycomb structure. There is no hint given to provide slits crossing the planes of a plurality of said planar partition walls in the structure, i.e. crossing the partition walls. The wording of claim 1 of document D1 concerning the slits for adjusting the electrical resistance of the structure seems to be directed to this embodiment of Figure 11 (see reference sign 118 of Figure 11 in connection with the slit stated in claim 1).

6.1.5 The cross-appellant is of the opinion that according to the wording of claim 1 of document D1 the insulating layers can be replaced and are even suggested to be replaced in an alternative construction by slits or slots.

However, no embodiment of this so called alternative construction is shown or described in this document D1. Even if the insulating layers were taken out of the structure, suggesting thereby the presence of slits or slots in that structure, these slits or slots would extend along the partition walls in the same manner as the insulating layers (see embodiments of Figures 5, 6,

8 and 10) and they would therefore not cross a plurality of these walls.

It is true that the insulating layers are lying inside the folded honeycomb structure but these layers are not put **into** that structure, crossing thereby partition walls and disrupting that structure, on the contrary these layers are lying along that structure, without disrupting it. This is the result of folding an existing unitary structure (see Figure 7 for example).

By the provision of ceramic pieces, as proposed in Figure 9 with regard to a gap solely between the outer partition walls of the structure and the casing wall for keeping the adjacent walls in distance from one another, it would be difficult to provide a gap by these pieces inside the honeycomb structure and to prevent electrical contact between the adjacent walls. The cross-appellant mentioned in this respect claim 11 of document D1, wherein it is clearly indicated that the insulating **layers** may exist of ceramic parts. A gap open for fluid flow is not disclosed therein. Figure 6 of document D1 furthermore shows an embodiment in which the honeycomb structure is divided into two parts. The two structure parts however are fixed on supporting walls (65, 66, 69) therebetween, which cannot be omitted.

In view of the whole disclosure of document D1, the board cannot detect a clear teaching which would lead the skilled person towards the presence of slits **in** a honeycomb structure as defined in the present claim 1.

6.1.6 It is true that document D6 discloses an element with a

honeycomb structure in which slits are provided which are open for axial fluid flow and extend in the axial length of the structure parallel to the axial direction thereof and cross the planes of a plurality of the planar partition walls. However, these slits are provided to allow stretching of the material in order to prevent cracking when the elements are heated and they are dimensioned to be closed at the operation temperature (see column 2, lines 45 to 48). Nothing is mentioned about adjusting the electrical resistance in the structure by these slits. Document D3 also discloses a honeycomb structure with slits along the partition walls. These slits however again are provided for preventing thermal cracking. Therefore, document D6 and document D3 cannot lead to the heating element of claim 1, particularly since these slits are not intended to create current paths.

6.1.7 Even if the skilled person were to select, without any inventive merit, a structure with planar partition walls as disclosed in documents D2, D5 or D7 he would therefore not obtain the heating element of claim 1.

6.2 Claims 12 and 15

6.2.1 The cross-appellant is of the opinion that in document D1 a clear hint is given on page 6, lines 6 to 16 to a monolith honeycomb structure produced by powder metal. However, this alternative embodiment described therein and apparently claimed in independent claim 16 of document D1 is disclosed with regard to the heating control and not with regard of adjusting the electrical resistance of the honeycomb structure by slits or variations in the partition wall axial lengths over the

honeycomb structure, as claimed in claims 12 and 15 of the impugned patent. There is no hint given in document D1 to provide a monolithic honeycomb structure with slits for adjusting the electrical resistance.

6.2.2 Document D3 which describes a heater with a monolithic honeycomb structure with a plurality of discontinuities formed by slits (see Fig. 9a) in the interconnected cell walls does not comprise any indication to provide the slits in combination with an electrical heater in order to determine the electrical resistance. Document D3 therefore cannot lead to the alternatives (i) and (ii) of claims 12 and 15 of the impugned patent.

6.2.3 Document D7 which also concerns an electric heater with a monolithic honeycomb structure does not propose to provide a slit or slits in the honeycomb structure to adjust the electrical resistance. This document D7 therefore also cannot lead to the alternatives of claims 12 and 15.

6.2.4 The cross-appellant cited with respect to the alternative (iii) of claims 12 and 15 the embodiment of Figure 11 of document D1. The embodiment of Figure 11 of document D1 however may lead to adjust the length of the whole honeycomb structure but does not give any information about a variation of the length of the partition walls in one honeycomb structure.

6.3.5 The resistance heater of claim 15 and the method of making such a resistance heater according to claim 12 therefore involve an inventive step (Article 56 EPC).

7. In view of the above the patent can be maintained with

the claims, description and drawings as filed in the oral proceedings (see section III).

8. *Reimbursement of the appeal fee*

The board does not agree that the decision of the opposition division is the result of a substantial procedural violation. The matter of Figure 11 of document D1 had been discussed in the opposition proceedings. In inter partes proceedings, a party must always be aware that arguments brought forward by an opposing party may be used by the deciding body. If a party has raised an objection to which the affected party did not respond, Article 113(1) EPC is not violated by the fact that the deciding body takes over that argument as their own in their decision without informing the affected party beforehand (see eg. decision T 405/94). The request for reimbursement of the appeal fee must therefore be refused.

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 a patent on the basis of the following documents:

Claims: 1 to 16,

Description: Pages 2 to 8,

Drawings: Figures 1 to 5, 6a to 6c, 7a, 7b, 9 to
13,

all as submitted in the oral proceedings.

3. The request for reimbursement of the appeal fee is refused.

The Registrar:

The Chairman:

G. Magouliotis

C. Andries