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**D E C I S I O N**  
**of 13 November 2002**

**Case Number:** T 0987/02 - 3.2.3

**Application Number:** 95909579.5

**Publication Number:** 0741853

**IPC:** F27D 1/12, F27D 9/00

**Language of the proceedings:** EN

**Title of invention:**  
Internal refractory cooler

**Applicant:**  
THE UNIVERSITY OF MELBOURNE, et al

**Opponent:**  
-

**Headword:**  
-

**Relevant legal provisions:**  
EPC Art. 54, 56  
EPC R. 67

**Keyword:**  
"Novelty - main request - no"  
"Novelty and inventive step: claim 1 of auxiliary request - yes"  
"Remittal to the first instance for further prosecution"  
"Reimbursement of appeal fee - no (no substantial procedural violation)"

**Decisions cited:**  
-

**Catchword:**  
-



Case Number: T 0987/02 - 3.2.3

**D E C I S I O N**  
of the Technical Board of Appeal 3.2.3  
of 13 November 2002

**Appellant:**

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**Representative:**

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**Decision under appeal:**

Decision of the Examining Division of the  
European Patent Office posted 19 March 2002  
refusing European application No. 95909579.5  
pursuant to Article 97(1) EPC.

**Composition of the Board:**

**Chairman:** C. T. Wilson  
**Members:** U. Krause  
J. P. B. Seitz

## Summary of Facts and Submissions

- I. The appeal contests the decision of the Examining Division dated 19 March 2002 to refuse European patent application No. 95 909 579.5 for lack of novelty in view of document US-A-4 097 679 (D3).
- II. The applicant (hereinafter denoted appellant) filed the notice of appeal on 17 May 2002 and paid the appeal fee on the same day. Together with the statement of the grounds of appeal he submitted, on 26 July 2002, four sets of claims corresponding to a main request and three auxiliary requests, and a report by Dr Neil B Gray, one of the inventors of the application.

With communication dated 25 November 2002 and issued for the preparation of oral proceedings to be held on request of the appellant, the Board informed the appellant of its preliminary opinion, expressing doubts about the allowability of the requests.

During oral proceedings held on 13 November 2003 the appellant replaced the three auxiliary requests by a single auxiliary request comprising claims 1 to 16.

- III. The main request and the auxiliary request each comprise a first independent claim directed to a wall lining for a furnace and a second independent claim directed to a method for lining a furnace.

The independent claims of the main request read as follows:

"1. A wall lining for a furnace having an outer shell and a source of external coolant in conjunction with the outer shell, said wall lining comprising a refractory lining adjacent the outer shell, the refractory lining having a hot face exposed to high temperature during operation of the furnace, the refractory lining including a plurality of elements of high thermal conductivity material, the elements extending into the refractory lining towards the hot face, each of the elements providing a continuous heat conduction path from the end of the element located closer to the hot face to the outer shell of the furnace, characterised in that the elements are dispersed in the refractory lining such that said elements are relatively concentrated in hot spots in said furnace and a relatively lesser number of elements are located in cooler parts of said furnace, to provide a substantially uniform temperature across the hot face of the furnace in the vicinity of the elements."

"13. A method for lining a furnace with a wall lining comprising a refractory lining having a plurality of elements of high thermal conductivity, the elements extending from an outer shell of the lining into the refractory lining, characterised in that said method comprises:

- (a) calculating heat flux through the wall lining required to obtain a desired temperature at a hot face of the wall lining;

- (b) determining a thickness of the wall lining and a thermal conductivity of the wall lining required to obtain said heat flux calculated in step (a);
  - (c) determining positioning and spacing of said plurality of elements in said wall lining required to obtain said thermal conductivity; and
  - (d) providing said furnace with said wall lining, said elements being in thermal contact with the outer shell, said wall lining providing a substantially uniform temperature across the hot face of the furnace during operation to said furnace,
- wherein said elements are concentrated in hot spots of said furnace and a relatively lesser number of elements are positioned in cooler parts of said furnace."

Whereas the preamble of claim 1 of the auxiliary request corresponds to that of claim 1 of the main request, its characterising portion is worded as follows:

"characterised in that the elements are dispersed in the refractory lining such that said elements are relatively concentrated in hot spots in said furnace and a relatively lesser number of elements are located in cooler parts of said furnace, and the plurality of elements of a high thermal conductivity material extend into the refractory lining towards the hot face of the furnace but do not extend throughout the refractory lining to provide a substantially uniform temperature across the hot face of the furnace in the vicinity of the elements."

Independent claim 12 of the auxiliary request corresponds to claim 13 of the main request.

IV. The following prior art was taken into consideration:

D1: JP-A-5-9542 and English translation thereof, as submitted by the Appellant on 26 August 1999

D2: US-A-5 058 534

D3: US-A-4 097 679

D4: DE-A-1 944 415

D5: US-A-3 849 587

V. The appellant requests that the decision under appeal be set aside and that a patent be granted on the basis of either his main request or his auxiliary request. He also requests reimbursement of the appeal fee.

VI. The arguments of the appellant in support of his requests can be summarized as follows:

*Allowability of the main request*

The invention as claimed in claim 1 was based on the concept of distributing the heat conducting elements in a zone of the furnace lining so as to obtain a substantially uniform temperature across the hot face of the lining in that zone. Document D3, which was considered as novelty destroying in the decision under appeal, mentioned neither such a uniform temperature nor a maximum temperature which should not be exceeded in order to avoid erosion but referred to a desired balance between heat flux into and out of the lining.

In combination with the uniform thickness of the lining derivable for example from column 2, lines 66 and 67, this balance would lead to a highly non-uniform temperature distribution whereby the hot spots remain hot and the cold spots cold. Thus, erosion would not be avoided. This was the reason why it represented outdated thinking and never played any role in practice. None of the remaining documents provided a pointer towards the inventive concept of reducing thermal stresses and thereby increasing longevity of the lining by adopting a cooling element distribution giving rise to temperature uniformity.

Claim 1 further specified that the elements provide a continuous heat conduction path to the outer shell of the furnace, which was distinguished from D3 where the elements ended at a cooled part of the lining and did not extend to the outer shell of the furnace.

Claim 13 defined the essential steps to be taken, in a modelling approach, to arrive at the furnace lining of claim 1. Thus, the method of claim 13 was distinguished from the prior art in the same manner as the lining of claim 1. Further, none of the available documents disclosed the steps outlined in claim 13 and the finding, in the decision under appeal, that these steps merely reflect "the standard ones that a skilled person would use for manufacturing that lining" was a mere unsubstantiated assertion not supported by evidence or detailed reasoning.

*Allowability of the auxiliary request*

The fact that, in D3, the cooling elements extend right through the refractory material caused a significant temperature variation across the hot face even if in operation the tips were covered by a slag layer which, moreover, had a tendency to fall off or to be scratched off in practice. Recessing the elements from the hot face, as claimed in claim 1 of the auxiliary request, had a damping effect on the temperature variations, thereby further reducing the thermal stresses. This solution could be derived neither from D1 where the length of the elements was determined by the requirements of supporting the refractory bricks and of avoiding air gaps in the heat conduction path by matching the expansion characteristics of the refractory material and of the elements, nor from D5 where the length was determined by the amount of heat to be conducted from the refractory lining for freezing slag onto the hot face of the lining, causing localized cooling and thereby increasing the lateral temperature variations.

The arguments in favour of claim 13 of the main request also applied to claim 12 of the auxiliary request.

*Reimbursement of the appeal fee*

A reimbursement of the appeal fee was to be ordered because the argument used in the contested decision that novelty was lacking because, during use of the invention, the refractory would recede until the cooling elements extended all the way through the refractory, was never raised before. Hence, the



decision was based, at least partially, on grounds or evidence which the applicants did not have an opportunity to consider.

## **Reasons for the Decision**

1. The appeal meets the requirements of Articles 106 to 108 EPC and of Rules 1(1) and 64 EPC and is, therefore, admissible.
2. *Main request*
  - 2.1 Claim 1 of the main request differs from the version on which the decision under appeal was based in that the substantially uniform temperature across the hot face of the furnace shall prevail in the vicinity of the elements instead of across the entire hot face of the furnace. This amendment is based on the original claim 1 which likewise limited the substantially uniform temperature to the vicinity of the elements, i.e. the zone of the furnace where the elements are located, not necessarily including the entire hot face of the furnace. By comprising the additional feature, as compared with original claim 1, of dispersing the elements in the lining such that they are relatively concentrated in hot spots in the furnace and a relatively lesser number of elements are located in cooler parts of the furnace, claim 1 of the main requests corresponds to a combination of original claims 1 and 3.

Likewise, independent claim 13 is based on a combination of original claims 15 and 16.

Thus, no objection under Article 123(2) arises.

- 2.2 Concerning the issue of novelty the appellant argued, having reference to the report of Dr Gray, that document D3 taught to balance heat flux into and out of the lining in combination with a uniform thickness of the lining, which would lead to a highly non-uniform temperature distribution whereby the hot spots remain hot and the cold spots cold. The Board cannot concur with this interpretation of D3. In fact, it is stated at column 2, lines 54 to 56, of D3 that the fin thickness and spacing is determined to balance both exhaust and intake heat volumes at a desired refractory thickness but there is no teaching that this desired thickness shall be uniform all over the furnace. The Appellant relies on the text at column 2, lines 62 to 68, specifying a "constant" thickness (obviously this thickness refers to the refractory, rather than to the fins) "along the entire circumference of the side walls". If this was a complete citation, the argument of the Appellant could be accepted. However, the passage in question continues by stating that the constant thickness should be maintained "throughout a long period of operation". There is no ambiguity, as argued by the Appellant, as to whether the term "constant" should define a uniform thickness, i.e. a thickness constant in space, or a thickness constant in time. In fact, it can be derived from a number of other statements made in D3 that this document is concerned with a refractory thickness which should not change in time, for example by mentioning, at column 2, lines 48 to 51, the effect that, if the exhaust heat volume is smaller than the intake heat volume, the walls become

eroded and recede to a certain thinner thickness, reaching a point of equilibrium, and, at column 4, lines 9 to 11, that no sizable change in the refractory thickness occurs after tens of melts. Thus, the skilled reader will understand document D3 as teaching to select the fin thickness and spacing at a particular location so that, given the heat load prevailing at that location, the refractory material erodes only to such an extent that a predetermined desired thickness is reached, whereby the heat flux into and out of the refractory material is balanced.

This teaching is consistent with the knowledge of the skilled person who is aware that erosion of the refractory material occurs if the temperature at the hot face exceeds a predetermined erosion temperature limit. This basic knowledge, a description of which can be found in document D5, lines 6 to 14 of column 2, is referred to at column 2, lines 48 to 51, of D3 by mentioning an imbalance of the heat fluxes whereby the exhaust heat volume, i.e. the heat flux out of the refractory material, is smaller than the intake heat volume, i.e. the heat flux into the refractory material. Thus, the condition for the fin thickness and spacing in combination with a desired refractory thickness at a particular location, as derivable from D3, implies that the temperature at the hot face of the refractory material having that desired thickness stays below the temperature causing erosion, otherwise further erosion would make the refractory material recede to an even smaller thickness. On the other hand, D3 at column 2, lines 51 to 53, points to the negative effect on heat loss of an imbalance in the sense that the exhaust heat volume is larger than the intake heat volume. Since

this situation corresponds to a further decreasing hot face temperature, the skilled person will derive that a hot face temperature falling below the allowable temperature to prevent further erosion should be avoided in order to limit heat losses. In summary, the above teaching derivable from D3 implies that the temperature at the hot face of the refractory material is close to the erosion temperature in order to prevent both further erosion and unnecessary heat losses. Since this condition applies to the selection of the fin thickness and spacing according to the specific heat load at its location (see column 2, lines 62 to 68), and to hot spots and the rest of the walls being subject to different heat loads (see column 4, lines 18 to 22), the temperature across the hot face of the furnace will be, as a function of the fin distribution, substantially uniform in the zone of the fins which may be provided in the entire area of the walls of the furnace.

Thus, it can be concluded that the condition of obtaining a substantially uniform temperature across the hot face of the furnace, although not expressly mentioned in D3, will automatically be obtained when following the teaching of this document. There is, therefore, no difference in this respect between the subject-matter of claim 1 and document D3.

- 2.3 The Appellant further points out that according to claim 1 the elements provide a continuous heat conduction path to the outer shell of the furnace, which was distinguished from D3 where the elements ended at a cooled part of the lining and did not extend to the outer shell of the furnace.

Taking into consideration that claim 1 is directed to a wall lining for a furnace having an outer shell, the feature referred to by the Appellant defines the wall lining only to the extent that the heat conducting elements within the lining should be adapted or suitable to provide a continuous heat conduction path to a cooled outer shell which forms part of the furnace in which the lining is to be used. In D3, the uncooled shell is formed by the furnace shell plate (7), and the heat conducting elements (2) are part of a cooled panel (1) which is separated from the shell plate by a gap and attached to it by fasteners (see column 3, lines 59 to 61). It is, therefore, evident that the heat conducting elements (2) of D3, being cooled by the coolant flowing through channels within the panel itself, are neither adapted nor suitable to provide a continuous heat conduction path either to shell plate (7) or to any other furnace shell for cooling. However, it is irrelevant for the heat removal from the refractory material by the heat conducting elements whether the latter are part of a separate cooled panel, as in D3, or directly attached to a cooled furnace shell, as for example disclosed in document D1. The skilled person will therefore consider using dispersed heat conducting elements, as disclosed in D3, in combination with either furnace design.

- 2.4 Since the subject-matter of claim 1 of the main request lacks inventive step, the main request cannot be allowed.

3. *Auxiliary request*

3.1 According to claim 1 of the auxiliary request the substantially uniform temperature across the hot face of the furnace in the vicinity of the elements is provided not only by the dispersion of the elements so as to concentrate the elements in hot spots but also by the fact that the elements extend into the refractory lining towards the hot face of the furnace but do not extend throughout the refractory lining. In the decision under appeal it was held that this additional feature was also derivable from D3 showing vertical fins not extending throughout the refractory material, the fins not only reinforcing the structure but also having a cooling effect. The Board does not share this view. In fact, even if a cooling effect of the vertical reinforcing fins cannot be excluded, the spacing and thickness of these fins is determined by the requirement of supporting the refractory material (see column 2, lines 58 to 61) and, therefore, follows considerations which are different from those governing the spacing and thickness of the horizontal heat conducting fins. In other words, it cannot be concluded from the fact that the vertical fins do not extend throughout the refractory lining that the horizontal fins should likewise not extend throughout that lining, or, vice versa, that the vertical fins should also be dispersed according to the heat load so as to keep the surface temperature below the erosion limit.

3.2 It can be derived from figure 5 of the application that heat conducting elements not extending all the way through the refractory lining reduce the lateral temperature variation at the hot face of the lining.

This can be explained by the high heat flux density, and corresponding large temperature drop, between the tips of the elements and the hot face of the lining. As a consequence of the resulting smoother lateral temperature profile the thermal stresses within the refractory material close to the hot face will also be reduced, improving the longevity of the lining.

Although the substantial uniformity of the temperature across the hot face of the furnace is a consequence of the fin design concept employed in D3 (see point 2.2 supra), this document is not concerned with lateral temperature variations. Indeed, quite large temperature differences and gradients will exist between the fins and the adjoining refractory material as well as within the region of the refractory material close to the fins. According to column 3, lines 54 to 56 the tips of the fins are coated, during operation, with a slag layer but this layer is for protection rather than for smoothing out lateral temperature variations.

Cooling fins extending partly through the refractory material are disclosed in documents D1 and D5. D1 is concerned with the problem of an air gap formed, during operation, between bricks made of a refractory material and the cooled shell, which air gap blocks the heat conduction from the bricks to the shell, and intends to bridge this gap by providing fins extending into the refractory material with a length of at least half the thickness of the refractory lining (see abstract). In D5 the length of penetration of the cooling fins into the refractory material is determined by structural considerations of the lining (see column 6, lines 25 to 27). Thus, it is evident that in both documents the

length and extension of the cooling elements into the refractory material is not determined by considerations concerning the effect of lateral temperature variations on the thermal stresses within the refractory material and, therefore, on the longevity of the lining.

Document D2 is concerned with a particular structure of elements holding and cooling a ceramic coating at the heat-loaded side of a pipe wall and does not consider the effect of the elements on thermal stresses within the ceramic coating. Document D4 discloses refractory material with integrated heat-conducting structures for equalizing temperatures within the refractory material. This teaching would suggest, when applied to the wall lining of D3, integrating laterally extending heat-conducting structures for eliminating or reducing the lateral temperature variations, rather than reducing the length of the fins in D3.

It can be concluded that a skilled person faced with the problem of reducing the thermal stresses in the refractory material to thereby improve the longevity of the lining could not obtain any useful advice in this respect from the available documents. Hence, it was not obvious, in view of the available prior art, to choose a reduction of the length of the heat conducting fins in D3 so that the fins end within the refractory material, a measure known to overcome other problems in the prior art, in order to solve this specific problem. Claim 1 of the auxiliary request is, therefore, considered to involve an inventive step.



3.3 Claim 12 of the auxiliary request is an independent claim concerning a method for lining a furnace. This claim corresponds to claims 13 and 12 of the main and auxiliary requests, respectively, considered in the decision under appeal. In this decision it was stated that the process steps defined in these claims "are the standard ones that the skilled person would use" for manufacturing the lining defined in the independent claim 1 which was found to lack novelty in view of D3. Since no further reasoning or substantiation was presented for explanation, the reader of the decision is not in a position to understand how the Examining Division arrived at this finding. The decision does not, therefore, meet the requirements of Rule 68(2) EPC in this respect.

It is noted that no further guidance as to why the subject-matter of the independent method claim was considered obvious can be derived from the file. In the communication dated 16 April 1999 it was merely stated that "the method steps are obvious to the skilled person" (page 3, point 5), and the further communication dated 10 July 2000 made reference to this statement without further substantiation (page 2, point 3). The communication of 2 August 2001, issued as annex to the summons to attend oral proceedings, did not mention the method claim, and the minutes of the oral proceedings are likewise silent about that claim. It is, therefore, evident that the independent method claim has not yet received due attention. Whilst this was acceptable as long as the set of claims was not allowable owing to a lack of novelty of claim 1, a thorough examination of this claim is essential in the present situation where claim 1 of the auxiliary

request is patentable and the allowability of this request therefore depends on the patentability of the method claim 12.

The Board has, therefore, decided to remit the case to the first instance for further prosecution, in particular for the examination as to whether the method claim 12 meets the requirements for patentability. This examination will have to take into consideration not only the requirement of novelty and inventive step but also that of clarity. For example, it will have to be determined whether the method steps (a) to (d) define, in a clear manner consistent with the description, all the steps necessary to arrive at the non-uniform distribution of the elements, as specified in the last three lines of the claim, to obtain the substantially uniform temperature across the hot face of the furnace defined in step (d).

4. *Reimbursement of the appeal fee*

Pursuant to Rule 67 EPC the reimbursement of the appeal fee shall be ordered in the event that the appeal is deemed allowable, if such reimbursement is equitable by reason of a substantial procedural violation.

In the present case the appeal was allowed at least as far as the auxiliary request is concerned. The Appellant pointed out that the contested decision relied on a new argument for suggesting that novelty is lacking, and that he had no opportunity to address this ground in contravention of Article 113(1) EPC. Indeed, the argument referred to in the fourth paragraph of page 5 of the contested decision obviously had never

been raised before and there was no opportunity for the Applicant to comment, which clearly constitutes a procedural violation. However, it is noted that the new argument was presented as an additional remark made after coming to the conclusion, in the preceding paragraph, that claim 1 lacks novelty for other reasons. It is, therefore, evident that this remark has not played any part in the decision on novelty of claim 1 and that the procedural violation is not so substantial as to warrant a reimbursement of the appeal fee.

Claim 12 of the auxiliary request was not duly considered which, however, cannot constitute a substantial violation either because it did not affect the decision to refuse the application which was based on a lack of novelty of claim 1. This also applies to the inadequate reasoning, in the contested decision, with regard to the lack of inventive step of claim 12.

For these reasons the request for reimbursement of the appeal fee cannot be allowed.

**Order**

**For these reasons it is decided that:**

1. The decision under appeal is set aside.
2. Claim 1 of the auxiliary request is novel and inventive.
3. The case is remitted to the first instance for further prosecution.
4. The request for reimbursement of the appeal fee is refused.

The Registrar:

The Chairman:

A. Counillon

C. T. Wilson