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# D E C I S I O N
## of 9 May 2001

**Case Number:** T 0726/97 - 3.3.5

**Application Number:** 93902385.9

**Publication Number:** 0621858

**IPC:** C03C 13/00

**Language of the proceedings:** EN

**Title of invention:**
Saline soluble inorganic fibres

**Applicant:**
The Morgan Crucible Company PLC

**Opponent:**
-

**Headword:**
Fibres/MORGAN

**Relevant legal provisions:**
EPC Art. 123(2), 84, 83, 56

**Keyword:**
"Upper and lower limits of several ranges of a glass composition taken from the examples"
"Amendments allowable only in exceptional circumstances"

**Decisions cited:**
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**Catchword:**
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Beschwerdekammern | Boards of Appeal | Chambres de recours

**Case Number:** T 0726/97 - 3.3.5

# D E C I S I O N
## of the Technical Board of Appeal 3.3.5
## of 9 May 2001

**Appellant:** THE MORGAN CRUCIBLE COMPANY PLC
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**Representative:** Boff, James Charles
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**Decision under appeal:** Decision of the Examining Division of the European Patent Office posted 26 February 1997 refusing European patent application No. 93 902 385.9 pursuant to Article 97(1) EPC.

**Composition of the Board:**

**Chairman:** R. K. Spangenberg
**Members:** M. M. Eberhard
M. B. Günzel

## Summary of Facts and Submissions

I. European patent application No. 93 902 385.9 was refused by a decision of the examining division posted on 26 February 1997. The decision was based on claims 1 to 7 filed with the letter of 3 October 1996 as the second auxiliary request.

II. The ground for the refusal was that the subject-matter of claims 1 to 7 did not involve an inventive step having regard to the teaching of WO 89/12032 (hereinafter D1). The successful passing of the ASTM-119 fire test at a peak temperature of 1010°C made the refractory fibres disclosed in D1 prime candidates for use in a refractory insulation material at service temperatures of 1000°C or higher. Routine testing would have revealed that the fibres were not only useable at a short-time peak temperature of 1000°C but also continuously at 1000°C or higher. The subject-matter of claims 1 and 2 was also obvious over the teaching of WO 87/05007 (hereinafter D2).

As an additional remark, the examining division further considered that the application did not comply with the requirements of Articles 84 and 83 EPC. Samples B3-5a, B3-20 and 660 whose compositions, for all practical purposes, fell within claim 1, exhibited shrinkage values well outside the claimed range. It appeared a priori unlikely that a fibre having a slightly higher silica content and similar amounts of the other components would have the desired low shrinkage values. Therefore the claims appeared to be speculatively broad. There was no general teaching in the application which allowed to predict fibre compositions having the desired low shrinkage. Already only minor variations in the silica content caused the shrinkage values to become completely unacceptable. The broad compositional

ranges for $SiO_2$, CaO and MgO, as defined in claim 1, led to a multitude of possible fibre compositions which could not be analysed with respect to shrinkage without undue burden.

III. The appellant lodged an appeal against this decision and submitted inter alia a declaration of Mr. Olds with the statement of grounds of appeal. In a communication, the board informed the appellant of its provisional opinion about the three sets of claims presented as the main request, and the first and the second auxiliary requests with the letter of 3 October 1996. Oral proceedings were held on 16 March 2001. During the oral proceedings the appellant submitted four sets of amended claims as the main request and three auxiliary requests respectively. After deliberation the board announced that the decision would be given in writing. In a communication dated 12 April 2001 the board informed the appellant of its opinion that the subject-matter of claim 1 of the second auxiliary request filed on 16 March 2001 met the requirements of novelty and inventive step. The appellant's attention was further drawn to deficiencies which remained to be removed. On 4 May 2001 the appellant filed a replacement set of claims comprising only one claim as the sole request. The sole claim of this request reads as follows:

"1. Use as refractory insulation at temperatures of 1000°C or more of saline soluble fibres having a shrinkage of less than 3.5% when exposed to 1000°C for 24 hours and having a shrinkage of less than 3.5% when exposed to 800°C for 24 hours as measured by the method of the description, the saline soluble fibres

comprising vitreous fibres having a composition essentially free of alkali metal oxides and boron oxide and comprising (in weight %):

| | | |
|---|---|---|
| $SiO_2$ | >58% | - (for MgO≤10%) and |
| $SiO_2$ | >58% + 0.5(%MgO - 10) | - (for MgO≥10%) |
| $SiO_2$ | up to 71.24% | |
| CaO | 4.46% - 35.03% | |
| MgO | 1.71% - 22.31% | |
| $Al_2O_3$ | 0% - 2.57% | |
| $Na_2O$ | <0.05 - 0.65% | |
| $K_2O$ | <0.05 - 0.13% | |
| $Fe_2O_3$ | 0.08 - 0.40% | |
| $ZrO_2$ | <0.05 - 1.23%" | |

IV. The appellant's arguments concerning the issue of inventive step can be summarised as follows:

Starting from D1 or D2, the problem to be solved was to provide physiologically soluble fibres having a service temperature of greater than 815°C as indicated in the present application. D1 and D2 demonstrated maximum service temperatures of up to 815°C. They contained no information that the fibres were suitable for use at temperatures higher than 815°C. The disclosure about the continuous service temperature above 1500°F (816°C) in claim 52 of D1 was speculative since the sole data reported in the description were in Table 6 which disclosed a continuous service temperature of maximum 816°C for the low alumina content fibres. The ASTM-E119 test in D1 and D2 was stopped at two hours. This meant that the fibres were exposed to temperatures in excess of 900°C for about 1 hour 10 minutes and to temperatures in excess of 1000°C for about 10 minutes. This fire test was not useful in predicting the behaviour of the fibre faced with exposure to high temperatures for long durations (24 hours). Mr Olds'

declaration reinforced the fact that D1 and D2 in no way led one to suppose that the low shrinkage value of low alumina content fibres after exposure at a temperature of 1000°C for 24 hours was predictable from D1 and D2. The disclosure of D1 and D2 would have given no incentive to test the fibres.

V. The appellant requested that the decision under appeal be set aside and that a patent be granted on the basis of the claim according to the sole request filed on 4 May 2001.

## Reasons for the Decision

1. The appeal is admissible.

2. Claim 1 meets the requirements of Article 123(2) EPC. It is based on a combination of original claim 7 with features from the description as originally filed. The feature that the fibres can be used as refractory insulation at temperatures of 1000°C or more is directly and unambiguously derivable from the data in Tables 5, 7, and 8 of the description in combination with the definition of the maximum service temperature at page 3, 6th paragraph, and the further shrinkage data of Table 9. Original claim 7 discloses that the composition is essentially free of alkali metal oxides and boron oxide. As MgO and CaO may be present in the composition in high amounts, it is implicit that it was not intended to exclude all kinds of fluxing agents. The upper limit of 2.57% for the alumina content is disclosed on page 27, fourth paragraph, and in Table 9 (page 22, melt 924). Regarding the upper limit of 71.24% for the $SiO_2$ content and the ranges 4.46-35.03% CaO, 1.71-22.31% MgO, <0.05-0.65% $Na_2O$ and <0.05-0.13% $K_2O$, it is observed that these ranges represent a

restriction of the broader ranges disclosed in the original application for compositions all meeting the shrinkage requirements of less than 3.5% at both temperatures of 800°C and 1000°C. The upper and lower values of these ranges are extracted from examples listed in Table 9 for those compositions that are demonstrated to meet the shrinkage requirements and to be saline soluble (see page 21, melts A2-29, B3-16 and A2-26; page 22, melts B3-13 and B3-9; page 23, melt 586). The 29 exemplified compositions falling within the restricted ranges and which have been tested for their shrinkage at 800°C and 1000°C all fulfil the shrinkage and solubility requirements and disclose amounts of $SiO_2$, CaO, MgO, $Al_2O_3$, $Na_2O$ and $K_2O$ which are well distributed over the whole ranges claimed for these components. Concerning the $Fe_2O_3$ and $ZrO_2$ contents, no range at all is disclosed in the application. The ranges 0.08-0.40% for $Fe_2O_3$ and <0.05-1.23% for $ZrO_2$ are very narrow ranges which are based on values disclosed in the said 29 examples which were shown to meet the shrinkage and solubility requirements. The values of the limits are taken from these examples (see page 21, melt A2-29; page 22, melt 721; page 23, melt 714). The amounts of $ZrO_2$ and $Fe_2O_3$ used in the 29 examples all shown to fulfil the shrinkage and solubility requirements are well distributed over the whole ranges now claimed. It is not derivable from the description that compositions lying within the claimed ranges might not have the desired low shrinkage. The amounts of $ZrO_2$ and $Fe_2O_3$ in the said examples are also associated with very different values of the other components of the glass compositions. In these very exceptional circumstances, the board considers that the compositional ranges introduced into claim 1 are directly and unambiguously derivable from the application as filed.

3. The reference in claim 1 to the description in respect of the method of measurement of the shrinkage is considered to comply with the provisions of Rule 29(6) EPC. Taking into account the length of the method of measurement disclosed at pages 16 and 17 of the description and the way it is described, the board considers that its inclusion in claim 1 would negatively affect the conciseness thereof and thus that the present case represents an allowable exception.

4. The subject-matter of claim 1 is new with respect to the documents cited in the search report. A number of the fibre compositions disclosed in D1 fall within the claimed compositional ranges (see for example page 35, compositions 39, 44, 45, 48, 51, 52, 54, 55, 57; page 36, compositions 59, 60, 61, 62, 63, 64, 65, 66, 67, 69, 70, 72, 74, 75; page 37, compositions 83, 94; page 38, compositions 95, 96, 97, 101, 103); however, D1 does not disclose that these fibres can be used as refractory insulation at temperatures of 1000°C or more. The claimed subject-matter differs from the disclosure in D2 by the use as refractory insulation at temperatures of 1000°C or more and by the fibre composition.

5. D1 is considered to represent the closest prior art. It discloses a great number of saline soluble fibres having compositions which fall within the ranges stated in claim 1 (see point 4 above). According to D1 fibres having excellent refractory properties, eg high continuous service temperatures, would be advantageous and the highest service temperatures are obtained at zero percent alumina for fibres with alumina contents less than 30% . Continuous service temperatures of 1500°F and 1430°F, ie 816°C and 777°C, are reported in Table 6 for fibres containing no alumina and having a $SiO_2$/CaO/MgO ratio 60/40/0 and 60/30/10 respectively (see page 4, lines 27 to 29; page 10, lines 5 to 22;

page 47, Table 6). Claim 52 of D1 further discloses inorganic fibres having a silicon extraction of greater than about 0.02 wt% Si/day in a physiological saline solution, which further exhibit a continuous service temperature above about 1500°F, ie 816°C. These fibres have a composition consisting essentially of about 0.06-1.5 wt% of oxides selected from the group $Al_2O_3$, $ZrO_2$, $TiO_2$, $B_2O_3$, iron oxides and mixtures thereof; 60-70 wt% $SiO_2$; 0-1 wt% MgO; and the remainder consisting essentially of CaO, the total being 100 wt%. The service temperature is defined in D1 as that temperature at which the fibre does not soften and sinter and at which a felt or blanket made from the fibres does not have excessive shrinkage, excessive shrinkage being a shrinkage of greater than a 5% linear or bulk shrinkage after exposure at the temperature usually for 24 hours (see page 9, lines 16 to 27). Therefore, it is implicit from the disclosure in D1 that the fibres can be used as refractory insulation.

5.1 Starting from D1 as the closest prior art, the technical problem underlying the claimed use can be seen in the provision of physiologically soluble fibres which are suitable for use as refractory insulation at higher temperatures.

It is proposed that this problem be solved by the combination of features as defined in claim 1. The claimed subject-matter differs from the disclosure of D1 in that the fibres are used as refractory insulation at temperatures of 1000°C or more. In view of the shrinkage values and maximum service temperatures reported in Tables 5 to 9 of the description and of the solubility values indicated in Table 10, the board is satisfied that this problem has actually been solved by the use as defined in claim 1.

5.2 D1 discloses in claim 52 saline soluble fibres having both a solubility of greater than about 0.02 wt% Si/day in a physiological saline solution and **a continuous service temperature above 1500°F, ie 816°C** (see point 5 above for the compositions). The compositional ranges disclosed in this claim are relatively narrow compared to the composition of the fibres for which only solubility in physiological saline solutions is required (see for example claim 1 of D1). In view of this teaching the skilled person seeking a solution to the technical problem stated above would have contemplated testing the fibres having the compositions defined in claim 52 in order to determine their continuous service temperature in the range above 816°C and, thus, the temperature at which they could be used as refractory insulation. Considering the definition of the service temperature in D1, he would have determined the shrinkage of the fibres after exposure at different temperatures above 816°C for 24 hours. A standardised test for determining the shrinkage of ceramic fibres on heating was well-known to the skilled person before the priority date (see the ISO and British standards indicated on pages 16 to 17 of the present application). However doing so, he would not have arrived at the claimed subject-matter since claim 1 involves the use of fibres having a MgO content of 1.71 to 22.31 wt%, ie a MgO content higher than the upper limit stated in claim 52 of D1. D1 does not contain any information from which the skilled person could have inferred that fibres having compositions other than those indicated in claim 52 might also have a continuous service temperature above 816°C. On page 10 of D1 reference is made to the service temperatures listed in Table 2 for a number of fibres according to the invention of D1. However D1 does not disclose this Table 2. Continuous service temperatures higher than 816°C are reported in Table 6 (page 47), but only for

fibres containing 30% alumina. Table 4 discloses the results of the two-hour ASTM E-119 Fire Test. However, the rising temperature profile employed in this two-hour fire test shows that the fibres are exposed to temperatures rising from 927°C to 1010°C for about 1 hour and to temperatures from 1000°C to 1010°C for about 10 or 15 minutes. As pointed out by the appellant and in the declaration of Mr Olds, this fire test would not have permitted to predict the behaviour and the shrinkage of fibres exposed to high temperatures (1000°C) for the considerably longer period of 24 hours. The board sees no reason not to accept this argument. Therefore, the results of the two-hour fire test would not have given the skilled person an incentive to test the fibres having compositions other than those indicated in claim 52 of D1 for their shrinkage characteristics and continuous service temperature.

5.3 D2 discloses fibres which are soluble in physiological saline solutions and have a high continuous service temperature (see page 3, first paragraph). High continuous service temperatures are, according to D2, service temperatures of as high as 816°C, more precisely from 743°C to 816°C (see page 3, lines 27 to 31; page 4, lines 10 to 12; page 11, claims 4 to 6). All the fibres exemplified in Table I have a service temperature of from 743°C to 788°C and their compositions lie outside the claimed ranges. The fibres of Table II also have compositions lying outside the claimed ranges and neither their service temperature nor their shrinkage values are disclosed. Therefore, the fact that fibre G of Table II has a composition which is very close to the claimed ones would be of no assistance to the skilled person confronted with the problem stated above. As pointed out above in point 5.2 the two-hour fire test would not have permitted to predict the shrinkage characteristics after exposure at

1000°C for 24 hours. The fibres exemplified in Table III have a continuous service temperature of less than 800°C except for two fibres containing 40 and 46 wt% alumina, ie alumina contents which are far removed from those defined in claim 1. The fibre compositions of Table III all fall outside the claimed range. Therefore, D2 contains no information which in combination with the teaching of D1 would point towards the claimed subject-matter.

5.4 The remaining documents cited in the search report are far more removed from the claimed subject-matter than D1 and D2 and their disclosure would not have suggested the claimed subject-matter even in combination with the teaching of D1 and D2.

5.5 It follows from the above that claim 1 meets the requirement of inventive step set out in Articles 52(1) and 56 EPC.

6. Concerning the objections under Articles 84 and 83 EPC mentioned in the appealed decision as additional remarks, the board observes that the compositional ranges in amended claim 1 have been restricted for all the oxides present in the composition, the upper limit of alumina content being now 2.57 wt% instead of the objected value of <3.57%. Regarding the doubts expressed by the examining division that a fibre having a composition similar to those of samples 660 and B3-20 but with a silica content slightly higher than 58 wt% would meet the desired low shrinkage, the board observes the following. The silica content of these fibres, which have shrinkage values at 1000°C well above the claimed limit of 3.5%, is indeed very close to the lower limit of 58 wt% stated in claim 1. However, Table 9 also shows that the fibre composition 694 which contains 58.39 wt% silica, ie just above the claimed lower limit, and comparable amounts of the

remaining components leads to the desired low shrinkage values. In view of this example, it is credible that a fibre having a composition comparable to those of samples 660 and B3-20 but with a silica content slightly above 58% meets the shrinkage requirements. Regarding the undue burden objected to by the examining division, it should be noted, on the one hand, that the compositional ranges have been restricted, and on the other hand, that the description contains 29 examples of fibre compositions falling within the claimed ranges and all meeting the low shrinkage requirements. The appellant has argued that all the fibre compositions falling within the claimed ranges exhibit the desired low shrinkage and, in the absence of evidence to the contrary, the board has no reason not to accept this argument. Therefore, it is considered that the requirements of sufficiency of disclosure and support by the description set out in Articles 83 and 84 EPC are also met.

7. The appellant submitted amended pages 7 and 8 of the description with the request filed on 4 May 2001. However, Tables 9 and 10 on pages 21 to 26 of the description, which disclose 84 different fibre compositions including both compositions within the claimed ranges and compositions outside these ranges, were not amended. Taking into account the large number of compositions, it would be appropriate to clearly identify in Tables 9 and 10 those compositions illustrating the use according to the claimed invention and those which do not. Furthermore, it will be for consideration by the examining division whether the reference to the claim in the two last lines of amended page 7 of the description should be replaced by the text of the claim (see Guidelines for examination in the EPO, Chapter C III-6.6) and whether any adaptation of the drawings is necessary.

## 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 grant a patent with claim 1 according to the sole request submitted on 4 May 2001 and a description to be adapted, and, if necessary, the drawings.

The Registrar

G. Rauh

The Chairman

R. Spangenberg

B. Gü
H. Eb.