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D E C I S I O N
of 24 March 2000

Case Number: T 0672/95 - 3.4.3

Application Number: 88104734.4

Publication Number: 0284062

IPC: H01L 39/12

Language of the proceedings: EN

Title of invention:
Ceramic oxide superconductive composite material

Applicant:
SUMITOMO ELECTRIC INDUSTRIES LIMITED

Opponent:
Siemens AG
VACUUMSCHMELZE GMBH, Hanau

Headword:
Ceramic oxide superconductive composite material/SUMITOMO ELECTRIC INDUSTRIES LIMITED

Relevant legal provisions:
EPC Art. 56, 123(2), (3)

Keyword:
"Late-filed documents (admitted)"
"Added subject-matter (no)"
"Inventive step (yes) realization of problem contributes to the inventive step"

Decisions cited:
-

Catchword:
-

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Beschwerdekammern | Boards of Appeal | Chambres de recours

Case Number: T 0672/95 - 3.4.3

D E C I S I O N
of the Technical Board of Appeal 3.4.3
of 24 March 2000

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Decision under appeal: **Interlocutory decision of the Opposition Division of the European Patent Office posted 1 June 1995 concerning maintenance of the European patent No. 0 284 062 in amended form.**

Composition of the Board:

Chairman: R. K. Schukla
Members: E. Wolff
M. J. Vogel

Summary of Facts and Submissions

I. European patent No. 0 284 062 claiming the earliest priority date of 24 March 1987 from a prior Japanese patent application JP-69366/87, was maintained as amended pursuant to Article 102(3) EPC by the decision of the opposition division dated 1 June 1995. According to the decision, the patent as amended met the requirements of the EPC, in particular of novelty and inventive step having regard, inter alia, to the following prior art documents cited during the opposition proceedings:

D1: DE-A-1 490 242

D3: DE-A-1 640 198

D5: EP-A-0 282 286

D7: EP-A-0 281 474

D9: Physical Review Letters, Vol. 58, No. 9, March 1987, pp 908-910

D12: WO 88/02355

II. Opponent I filed a notice of appeal on 20 July 1995 and paid the appeal fee on the same day. The statement setting out the grounds of appeal was filed on 19 September 1995. The appellant requested that the decision of the opposition division should be set aside and the entire patent be revoked. The appellant also repeated a request, previously made during the opposition proceedings, for a further search to be carried out by the EPO in view of the amendments to

claim 1 incorporating subject-matter contained in the description.

During the appeal proceedings, the appellant cited and submitted the following further documents:

D13: DE-A-1 302 007

D14: US-A-3 796 553

D15: EP-A-0 308 326

D16: Nature, volume 325, 19 February 1987, pages 664 and 665

D17: DE-A-1 232 287

III. Oral proceedings were held on 24 March 2000. The appellant and the respondent appeared at the oral proceedings. Opponent II, although duly summoned, did not appear.

IV. At the oral proceedings the respondent submitted a new request replacing the previously filed request. Claim 1 of the request reads as follows:

"1. A ceramic oxide superconductive composite material comprising a ceramic oxide superconductor and a non-superconductive material comprising at least one element, said non-superconductive material not reacting with any of the elements of the ceramic oxide superconductor and being filled in the pores of the superconductor,

said non-superconductive material being selected from a

ferromagnetic material consisting of Gd, Tb, Dy, Ho, Er, Tm, Fe, Ni, or Co; or

from a paramagnetic material consisting of Au, Pt, or Pb; or

from a stabilizing material consisting of Cu, Al, Cu which contains Al dispersed therein, or a Cu-Ni alloy;

the weight ratio of the ferro- or paramagnetic material to the superconductor being from 1:1 to 1:9, and the weight ratio of the stabilizing material to the superconductor being from 5:1 to 1:9."

V. The appellant (opponent I) argued essentially as set out in the following paragraphs.

Concerning the issue of inventive step, the appellant submitted that:

(i) Ceramic oxide superconducting materials are known from document D9. The patent in suit is concerned with the problem of providing materials of the kind described in document D9, yet better suited to practical applications owing to improved thermal and mechanical properties. The solution adopted is to fill the pores of the sintered ceramic oxide superconductor with a ductile material. The same technique had been applied to conventional superconductors before the earliest priority date of the patent.

(ii) When viewed as solids, conventional superconductors and ceramic oxide

superconductors are very similar. Like ceramic superconductors, conventional superconductors, too, can exhibit brittleness such as beta phase tungsten structures, for example. When treated as solids, it is immediately clear that the same processing techniques are applicable to both kinds of material. Those processing technique are, moreover, applied by the same skilled person.

(iii) The skilled person to whom the patent addresses itself is not a scientist who is an expert in the field of ceramic oxide superconductors; instead, it is an engineer who is skilled in material processing of superconductors in general. In considering whether the claimed subject matter involves an inventive step, any distinction between conventional and high-temperature superconductors is therefore irrelevant.

(iv) Since the early nineties, all superconductors, whether conventional or ceramic, are processed in the same manner to provide superconductors in filamentary form. Also, techniques such as the "powder in a tube" technique, for example, in which a fine powder of superconducting material is contained within a corrosion-proof tube for the purpose of sintering, are now standard techniques in the manufacture of both conventional and high-temperature superconductors. Thus, techniques known from processing conventional superconductors are indeed applied by the skilled person to ceramic oxide superconductors.

(v) Document D1 concerns an improved method of manufacturing superconducting materials. The improved method provides some control of the critical temperatures, and the resulting materials are less brittle than other superconductive materials with similar transition temperatures (page 2, lines 6 to 15). Superconducting niobium tin (Nb_3Sn) and non-superconducting copper (Cu), both in finely ground powder form, are mixed and subsequently compacted into the desired shape. The mechanical strength of the resulting compact is further improved by firing in vacuo (Document D3, page 3, lines 10 to 17). In the resulting material, metallic particles are distributed among superconductive particles in the same manner as in the material claimed in the patent in suit, and in similar weight ratios (see document D3, page 3, lines 5 to 10). Moreover, the invention of the patent has as one of several goals an improvement in the mechanical properties of the superconducting material. According to document D1, this problem is solved in the prior art in the same manner. If a ceramic oxide superconductor disclosed in document D9 is substituted for the conventional superconductors described in document D1, the result is a material according to the claimed invention. The claimed invention is thus arrived at without the need for an inventive step.

(vi) Document D3 discloses a composite superconducting material which includes embedded magnetic particles and is structurally similar to the superconductive material as claimed in

the patent in suit. According to document D3, column 1, lines 39 to 54, fine particles of a hard magnetic material are distributed in a matrix (11) of a type II superconducting material. The superconducting materials are conventional type II superconductors which include, among others, alloys such as Hg-In and Nb_3Sn. The magnetic particles may be ferro-magnetic metals, such as Fe, Ni, Co and their alloys. Since ceramic oxide superconductors are known to be type II superconductors, they are of the same type as the superconductors described in document D3. The same ferromagnetic particles are also claimed as suitable filling materials in the patent in suit. There is no reason to suppose that the skilled person would not have applied the teaching of document D3 to the ceramic oxide superconductors known from document D9. Applying that teaching, the skilled person would have arrived at the structure claimed in claim 1 without an inventive step being required.

The appellant also submitted arguments in relation to the following issues:

(vii) Reference to Ag as material for filling the pores had been deleted from the description, and with a disclaimer excluded from the claims, during the opposition proceedings. The deletion had been necessary because document D5 was relevant prior art under Article 54(3)EPC. In view of document D15, also cited as prior art under Article 54(3), any reference to Ag_2O as a possible filling material also required

deletion.

(viii) Repeating a previously made request, the appellant argued that a further search ought to be carried out by the EPO because claim 1 had been amended to include porosity, a feature which had been taken from the description and which would not have been covered by the original search.

(ix) At the oral proceedings, the appellant withdrew the argument, raised for the first time earlier in the course of the appeal proceedings, that the patent should be revoked under Article 100(b) because in respect of Ag_2O it failed to disclose the invention in a manner sufficiently clear and complete for it to be carried out by a person skilled in the art.

VI. The arguments presented by the respondent in favour of the claimed invention involving an inventive step can be summarized as follows.

(i) Document D9 was published on 2 March 1987, that is, only three weeks before the earliest priority date of the patent. It is representative of the knowledge of the skilled person at the time concerning the properties of ceramic oxide superconductors.

(ii) Document D9 is also the appropriate prior art starting point for assessing the presence of an inventive step because, apart from document D16, which is a brief historic review, it is the only cited document which relates to ceramic oxide

superconductors.

(iii) As witnessed by document D9, and also by document D16, at the earliest priority date of the patent, 24 March 1987, ceramic oxide superconductors had been known for only a very short period. The material properties of the then newly discovered high temperature superconductors were only incompletely known and understood. In addition to having a different chemical composition to conventional superconductors, accompanied by a different superconductive behaviour, ceramic oxide superconductors have other properties which are unlike those of conventional superconductors, such as, for example, an unusually large effect of pressure on the transition temperature T_c. There had at the time been no investigation into what practical difficulties would arise from the attempted use of ceramic oxide superconductors. Given this lack of knowledge at the earliest priority date of the patent in suit, the skilled person would not have considered that documents relating to conventional superconductors would contain information relevant to processing the new ceramic oxide materials.

Reasons for the Decision

1. *Admissibility of the Appeal*

The appeal complies with the provisions of Articles 106 to 108 EPC, and is therefore admissible.

2. *Late filed documents - admissibility*

2.1 Claim 1 as maintained by the decision of the opposition division had been submitted only at the oral proceedings held during the opposition proceedings. The appellant had therefore been unable to adduce further evidence concerning the newly claimed subject matter during the opposition period in accordance with Article 99(1) EPC. Documents D13 and D14 were submitted as constituting such evidence. Document D15 was submitted to show that the use of Ag_2O as filling material lacked novelty under Article 54(3) EPC. Documents D16 and D17 were submitted subsequently to refute counterarguments made by the respondent. The Board considers there to be nothing in the late submission of these documents which would point towards an intention to abuse the procedure. The respondent did not object to the admissibility of the late filed documents. Documents D13, D14, D16 and D17 are relevant for determining whether the claimed invention involves an inventive step, and document D15 for determining whether the claimed invention is new.

Given the particular circumstances, the Board decides that admitting documents D13 to D17 into the appeal proceedings is justified.

3. *Added subject matter (Article 123(2) EPC)*

3.1 The amended claim 1 filed at the oral proceedings differs from claim 1 as originally filed in that it includes the further requirement that non-superconductive material of a kind that does not react with the elements of the superconductive material, is filled into the pores of the superconductor, and in

that it lists the non-superconducting materials and associated weight ratios.

3.1.1 The description of the European patent application forming the basis of the patent in suit refers throughout to the pores of the sintered ceramic oxide superconductor being filled with non-superconducting material (cf., e.g., page 5, last paragraph, and the paragraph bridging pages 8 and 9 of the application as filed). The requirement that the filling material must not react with the elements of the superconductor is referred to on page 5, last three lines.

3.1.2 The list of materials suitable for filling the pores of the superconductor is disclosed in the description on page 8, lines 22 to 26 for the ferro- and paramagnetic materials, and on page 9, lines 18 to 24 for the stabilizing materials; the respective weight ratios are disclosed on page 9, lines 7 to 9, and on page 10, lines 4 to 6, respectively.

3.2 Concerning the other claims, these are, with the exception of dependent claim 8, identical to the dependent claims as originally filed. Claim 8 as amended specifies that the superconductive composite "is further surrounded by" the stabilizing material rather than "is surrounded by" as claimed in claim 8 as originally filed. Since claim 7, from which claim 8 depends, specifies that the non-superconducting material in the composite of claim 1 is a stabilizing material, the change in the wording of claim 8 specifies that in addition to a stabilizing material filing the pores of the superconductor, the stabilizing material also surrounds the superconductor. The embodiment described with reference to Figure 2 on

page 11, lines 9 to 15 of the application as filed provides a clear basis for this amendment.

3.3 The description has been amended to bring it into line with the claims by deleting all reference to Ag and Ag_2O, which were contained in the original description as two of several examples of paramagnetic filling materials.

3.4 The Board is satisfied that, as a result of the amendments made to the description and claims, the skilled person is not presented with any subject matter which goes beyond the contents of the application as filed, and that the amendments therefore comply with the requirement of Article 123(2)

4. *Extension of the scope of protection (Article 123(3) EPC)*

4.1 Claim 1 as granted is identical to claim 1 as originally filed. The amended claim 1 filed at the oral proceedings thus differs from claim 1 as granted by the additional features referred to in paragraph 3.1. These additional features narrow the protection conferred by the claims as granted, so that the amendments satisfy the requirements of Article 123(3) EPC.

5. *Novelty (Article 54 EPC)*

5.1 Documents D5, D7 and D12, which constitute prior art pursuant to Article 54(3) EPC, were not relied upon by the appellant during the appeal proceedings. The Board is satisfied that claim 1 is novel with respect to

these prior art documents. Document D15 was submitted as prior art pursuant to Article 54(3). Document D15 contains the description of an embodiment of the invention in which Ag_2O is used for filling the pores of the superconducting material, and was cited because Ag_2O reduces to Ag during sintering. The description has been amended to exclude Ag_2O, and claim 1 does not contain Ag as an element. Hence, document D15 is no longer relevant to the issue of novelty.

6. *Inventive step (Article 56 EPC)*

6.1 As described in column 3, lines 30 to 37 of the patent in suit, the object of the invention is to provide ceramic oxide superconductors which have improved mechanical strength, stability, transition temperature T_c and critical current density, and which are thermally stable and hardly suffer from breaking of the superconductive state.

6.2 The invention achieves the stated objects by providing, according to claim 1, a ceramic oxide superconductor in which the pores of a matrix of ceramic oxide superconducting material are filled, within certain given weight ratios, with ferromagnetic, paramagnetic or stabilizing materials, as listed in the claim.

6.3 It was not disputed by the parties that at the priority date of the patent ceramic oxide superconductors had been known for a short period of about three weeks.

6.4 The appellant submitted that the appropriate skilled person is someone skilled in the art of processing superconducting materials rather than an expert in superconducting ceramic oxides, and that the same

skilled person is involved in the processing of both conventional and ceramic oxide superconducting materials. The Board agrees, since the invention concerns the mechanical, electrical and thermal properties of ceramic oxide superconductors rather than their superconductive properties.

6.5 There is no dispute that of the cited documents only documents D9 and D16 relate to ceramic oxide superconductors. The other documents which have been cited as relevant for deciding whether the claimed invention involves an inventive step relate to conventional superconductors. Document D16 is a historical review of the development of superconductors until shortly before the earliest priority date of the patent in suit and provides almost no technical details concerning ceramic oxide superconductors. Document D9 reports on some properties of ceramic oxide superconductors. Therefore, in the Board's view, the correct prior art starting point for deciding upon the presence of an inventive step is Document D9.

6.6 Document D9 was published on 2 March 1987, which is only some three weeks before the earliest priority date of the patent in suit. The document provides the following information about ceramic oxide superconductors:

(a) the chemical composition of ceramic oxide superconductors is different from the chemical composition of conventional superconductors (see, for example, page 908, left-hand column, lines 8 to 15),

(b) ceramic oxide superconductors display a

different kind of superconductive behaviour (see, for example, page 908, left-hand column, lines 24 to 34),

(c) ceramic oxide superconductors also have other properties which are different from those of conventional superconductors, such as, for example, an unusually large effect of pressure on the transition temperature T_c (page 908, right-hand column, lines 3 to 9), and

(d) at the time of publication of document D9, ceramic superconductors and their properties, including the mechanisms which lead to their superconductive behaviour, were only vaguely understood (see, for example, page 908, right-hand column, lines 9 to 25).

Document D9 does not mention any of the material properties of ceramic oxide superconductors other than that the material is sintered (page 908, right-hand column, lines 35 to 36). Nor does document D9 refer to any aspects of making these superconductors easier to use in practical applications.

6.7 The following information about the material properties of ceramic oxide superconductors is provided by the patent in suit itself. In particular:

(a) the superior superconductive properties of the surface layer of the ceramic oxide material compared to its interior ((column 2, lines 31 to 42),

(b) the need for oxygen to be present during the sintering process to achieve the desired superconducting properties (column 2, lines 43 to 47), and

(c) the conflict between, on the one hand, the need for large pores to allow the surface of the material to be in contact with oxygen during the sintering operation and, on the other hand, those effects of these large pores on the material which are undesirable, such as the consequent inability of the material to withstand mechanical stress (column 2, line 43 to column 3, line 1).

6.8 The respondent's argument as summarized in paragraphs VI (i) to (iii), is based on the fact that the properties of ceramic oxide superconductors were not known at the earliest priority date of the patent. Document D9 is said to represent what the skilled person had known about ceramic oxide superconductors at the priority date of the patent. Document D9, and also document D16, the only other cited document relating to ceramic oxide superconductors, are considered to illustrate the lack of information about these materials at the time, with document D16 even referring to some skeptics still doubting that the materials concerned were genuine superconductors (page 665, column 3, second paragraph). According to document D9, many fundamental matters such as the reasons for the superconductive behaviour or for the pressure sensitivity of the transition temperature were hardly understood at the time (see page 908, right-hand column, lines 10 to 16) and required considerable further investigation. In these circumstances the Board

does not find the appellant's argument convincing that, at the priority date of the patent, the skilled person would have routinely considered, or had any reason to consider, conventional superconductors and ceramic oxide superconductors to be sufficiently similar for techniques to improve the mechanical, electrical or thermal properties of the former to be applicable to the latter.

6.9 The problems to be solved by the invention are not apparent from either of the only cited documents relating to ceramic oxide superconductors, that is, documents D9 and D16. They are apparent only from the patent itself. Arguments to the effect that ceramic oxide superconductors suffer the same problems as conventional superconductors, and that those problems can be solved in the same manner as for conventional superconductors (see paragraph V (iv)) are thus based on ex post facto analysis and are therefore not convincing.

6.10 In the circumstances, and particularly in view of the lack of knowledge about the material properties of ceramic oxide superconductors, and in view of the fact that there was only a period of three weeks between the publication date of document D9 and the earliest priority date of the patent in suit, the Board is persuaded by respondent's argument that at the earliest priority date of the patent the skilled person would not have addressed the technical problem as set out in point 6.1 above. Thus, in the Board's view, the realisation of the problem itself contributes to the inventive step of the claimed subject matter. Consequently, it would not have been obvious for the skilled person to consider as relevant the measures

taught in document D1, D3, D13, D14 or D17 for conventional superconductors. The Board therefore considers it unnecessary to discuss the contents of these documents.

6.11 For the foregoing reasons, in the Board's judgement, the invention as claimed in claim 1 involves an inventive step within the meaning of Article 56 EPC.

7. *Ability to perform the invention(Article 100(b) EPC)*

The argument that in respect of Ag_2O the patent does not disclose the invention in a manner sufficiently clear and complete for it to be carried out by a person skilled requires no further consideration by the Board because of the withdrawal of this argument by the appellant and the deletion of any reference to Ag from the claimed subject matter by the respondent.

8. *Further search to be carried out by the EPO*

Additional searches by the opposition division may be carried out where there is doubt that elements introduced into the claims from the description were not covered by the original search (cf. "The Guidelines, D-VI, 5"). The opposition division had refused a request for a further search. The reason given for the refusal was that the search would have covered the feature concerned. The search would have been directed to the claims as interpreted with reference to the description, and it was clear from the description that the filling of the pores was an important aspect of the invention. The opposition division, in the Board's view, exercised its discretion reasonably, and therefore the Board does not consider

it justified to review that decision. In any event, in opposition proceedings it is for the opponent to adduce documents which support his case for the revocation of the patent.

Order

For these reasons it is decided that:

1. The decision under appeal is set aside.

2. The case is remitted to the department of the first instance with the order to maintain the patent on the basis of the following:

   - claim 1 as filed during the oral proceedings before the Board on 24 March 2000

   - claims 2 to 10 as filed during the oral proceedings before the opposition division on 9 May 1995;

   - description page 5 as filed during the oral proceedings before the Board on 24 March 2000

   - description pages 3, 4 and 6 as filed during the oral proceedings before the opposition division on 9 May 1995;

   - Figures 1 and 2 of the patent as granted.

The Registrar: The Chairman:

L. Martinuzzi R. Shukla