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D E C I S I O N
of 25 April 2006

Case Number: T 0507/04 - 3.4.03

Application Number: 94120753.2

Publication Number: 0661762

IPC: H01L 39/14

Language of the proceedings: EN

Title of invention:

Multifilamentary oxide superconducting wire and coil formed by the same

Proprietors:

Sumitomo Electric Industries, Ltd., et al

Opponent:

Siemens AG

Headword:

Multifilamentary oxide superconducting wire/Sumitomo Electric Industries, Ltd.

Relevant legal provisions:

EPC Art. 54, 56, 104, 108

Keyword:

"Appeal admissible - yes"
"Novelty - yes"
"Inventive step - no"
"Apportionment of costs - no"

Decisions cited:

-

Catchword:

-



Case Number: T 0507/04 - 3.4.03

D E C I S I O N
of the Technical Board of Appeal 3.4.03
of 25 April 2006

Appellant: Sumitomo Electric Industries, Ltd.
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Representative: Winter, Brandl, Fürniss, Hübner Röss, Kaiser,
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Respondent: Siemens AG
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Representative: -

Decision under appeal: Decision of the Opposition Division of the
European Patent Office posted 3 February 2004
revoking European patent No. 0661762 pursuant
to Article 102(1) EPC.

Composition of the Board:

Chairman: R. G. O'Connell
Members: E. Wolff
U. Tronser

Summary of Facts and Submissions

- I. This is an appeal against the revocation of European patent 0 661 762 for lack of novelty over document
- D10: The Design And Manufacture Of $(\text{Bi,Pb})_2\text{Sr}_2\text{Ca}_2\text{Cu}_3\text{O}_x$ Composite Conductors In Relation To Their Critical Current Capabilities, B A Glowacki, Cryogenics 1992, Vol. 32, ICMC Supplement, pages 508 to 515.
- II. The appellant proprietor requests that the decision be set aside and the patent be maintained as granted, or that the patent be maintained in amended form on the basis of an auxiliary request filed with the statement of grounds of appeal. The appellant proprietor further requests that the board make an order for apportionment of costs.
- III. The respondent opponent requests that the appeal be rejected as inadmissible, or as auxiliary request that the appeal be dismissed.
- IV. Independent claim 1 of the main request reads:
- "1. A superconducting wire (10) for a coil, consisting of a plurality of filaments (2) consisting of an oxide superconductor and a stabilizing material (1), consisting of silver or a silver alloy, covering said filaments,
- superconducting phases of said filaments (2) being rendered monophasic, with c-axes being strongly oriented along the thickness of said wire (10),

crystal grains of said superconductor forming said filaments (2) being in the form of flakes extending longitudinally along said wire, said crystal grains being bonded to each other,

a ratio obtained by dividing a sectional area occupied by said silver or said silver alloy by that occupied by said filaments being not more than 3 in a section of said wire (10)."

Independent claim 4 of the main request reads:

"4. An oxide superconducting coil being formed by winding a superconducting multifilamentary wire, consisting of a plurality of filaments consisting of an oxide superconductor and a stabilizing material (1), consisting of silver or a silver alloy, covering said filaments,

superconducting phases of said filaments being rendered monophasic, with c-axes being strongly oriented along the thickness of said wire,

crystal grains of said superconductor forming said filaments being in the form of flakes extending longitudinally along said wire, said crystal grains being bonded to each other,

a ratio obtained by dividing a sectional area occupied by said silver or said silver alloy by that occupied by said filaments being not more than 3 in a section of said wire,

a critical current value being at least 60% of that exhibited by said wire forming said coil in a magnetic field of at least 10 T."

V. Independent claim 1 of the auxiliary request reads:

"1. A superconducting wire (10) for a coil, consisting of a plurality of filaments (2) consisting of an oxide superconductor and a stabilizing material (1), consisting of silver or a silver alloy, covering said filaments,

superconducting phases of said filaments (2) being rendered monophasic, with c-axes being strongly oriented along the thickness of said wire (10),

crystal grains of said superconductor forming said filaments (2) being in the form of flakes extending longitudinally along said wire, said crystal grains being bonded to each other,

a ratio obtained by dividing a sectional area occupied by said silver or said silver alloy by that occupied by said filaments being in the range of 1.5 to 2 in a section of said wire (10)."

Independent claim 3 of the auxiliary request reads:

"3. An oxide superconducting coil being formed by winding a superconducting multifilamentary wire, consisting of a plurality of filaments consisting of an oxide superconductor and a stabilizing material (1), consisting of silver or a silver alloy, covering said filaments,

superconducting phases of said filaments being rendered monophasic, with c-axes being strongly oriented along the thickness of said wire,

crystal grains of said superconductor forming said filaments being in the form of flakes extending longitudinally along said wire, said crystal grains being bonded to each other,

a ratio obtained by dividing a sectional area occupied by said silver or said silver alloy by that occupied by said filaments being in the range of 1,5 to 2 in a section of said wire,

a critical current value being at least 60% of that exhibited by said wire forming said coil in a magnetic field of at least 10 T."

VI. In so far as they are relevant for the decision of the board, the arguments put forward by the appellant proprietor can be summarized thus.

The documents which were filed at a late stage of the opposition proceedings should not have been admitted into the proceedings. They should therefore be treated as not having been filed and not be examined as to their relevance during the appeal proceedings.

The decision of the opposition division was based on document D10. This document was filed late by the opponent. Its technical content was totally misinterpreted by the opposition division. Had the document not been misinterpreted, there would have been no finding of lack of novelty. Hence, for reasons of

equity the opponent should meet the costs of the proceedings.

- VII. In so far as they are relevant for the decision of the board, the arguments put forward by the respondent opponent can be summarized thus.

The patent included two sets of claims. The statement of the grounds of appeal confined itself to submissions in respect of only one of these sets. It also lacked any discussion of the further limitations introduced in the auxiliary request to confer an inventive step over document D10. The statement of the grounds was therefore defective. The appeal should therefore be rejected as inadmissible.

In the event that the board did not allow this main request, the respondent opponent requested that the appeal be dismissed since the inventions claimed in the appellant proprietor's main and auxiliary requests were either not new or, if found to be new, did not involve an inventive step over the disclosure in document D10.

The opposition division admitted document D10 into the proceedings and arrived at its decision taking into account the disclosure in document D10. Hence, the request for apportionment of costs was baseless and should be refused.

Reasons for the Decision

1. *Admissibility of the appeal*

- 1.1 The respondent opponent argued that the statement of the grounds of appeal addressed only the objections to the first of the two groups of claims; the statement was accordingly defective.
- 1.2 The appellant proprietor argued in support of the purported statement that it did address the issues raised by the opposition division in respect of document D10, by explaining in some detail how and why the document appeared to have been misinterpreted.
- 1.3 In fact claims 4 and 3 of the main and auxiliary requests respectively, directed to a coil, incorporate all the features of the respective claims 1 directed to the wire for making that coil. Thus, each of these claims is in substance nothing other than a dependent claim as defined in Rule 29(3) and (4) EPC, even if framed in the guise of an independent claim. The board is therefore satisfied that the arguments in support of claim 1 of the main and auxiliary request contain a complete reasoned argument against the decision under appeal: not merely an assertion that the impugned decision is incorrect, but rather an exposition of the legal or factual grounds alleged to justify setting aside the decision. This makes the appeal admissible.

2. *Admissibility of late filed documents*

2.1 Documents D7 to D11 were filed after expiry of the time limit under Article 99(1) EPC for filing an opposition. The opposition division admitted all these documents into the proceedings; documents D7 to D9 as having been filed in response to claim amendments, and documents D10 and D11 in view of document D1 possibly not being acknowledged as prior art under Article 54(2) EPC.

2.2 In respect of document D10, the appellant proprietor has withdrawn the request to have this document considered as not submitted in due time. Thus there is no reason to challenge the opposition division's decision with regard to document D10.

2.3 Furthermore admitting documents into opposition proceedings at a late stage lies within the discretion of the opposition division (Article 114(2) EPC). Absent any convincing reasons for considering the discretion to have been exercised wrongly, such a decision will not be reversed by a board of appeal. No such reasons have been submitted in the present case.

3. *Novelty*

3.1 Claim 1 includes reference to a ratio obtained by dividing a sectional area occupied by silver or a silver alloy by that occupied by the filaments. This is true of claim 1 of each of the requests in the opposition proceedings and the appeal proceedings.

3.2 In claim 1 of the main request and the patent as granted, this ratio is required to be not more than 3.

In the auxiliary request, which corresponds to the third auxiliary request in the opposition proceedings, the aspect ratio was limited to the range 1.5 to 2.

3.3 The opposition division concluded that the invention as claimed in claim 1 of each of the requests lacked novelty over the disclosure in document D10. This conclusion was based on the assumption that the parameter P in document D10 corresponded to the reciprocal value of the ratio claimed in the patent, and that the inverse values for P, being between 20 and 1.1 for the range 0.05 to 0.9, fell within the range of the claimed ratio of not more than 3 and also in the limited range of between 1.5 and 2.

3.4 The invention and document D10 both relate to $(\text{Bi,Pb})_2\text{Sr}_2\text{Ca}_2\text{Cu}_3\text{O}_x$ superconductors (so-called "2223" superconductors), and more specifically to composite Ag-2223 superconductors. Document D10 discloses a multifilamentary conductor, that is, a superconducting wire consisting of a plurality of filaments. The conductor is an Ag-2223 composite conductor made by the - known - modified tube technique, that is, an oxide superconductor is covered by a stabilizing material consisting of silver or a silver alloy, in which the almost pure 2223 phase is obtained by multistage cold deformation and sintering (D10, p.508, last paragraph). The process described in document D10 thus produces monophasic superconducting filaments with c-axes being strongly oriented along the thickness of the wire in which the crystal grains of the superconductor forming the filaments are in the form of flakes extending longitudinally along the wire and are bonded to each other. It was not in dispute that these features were

- common to the invention claimed in claim 1 and the disclosure in document D10.
- 3.5 Claim 1 of the main request includes the further requirement that a ratio obtained by dividing a sectional area occupied by said silver or said silver alloy by that occupied by said filaments be not more than 3 in a section of said wire (10). In the auxiliary request this ratio is limited to between 1.5 and 2.
- 3.6 According to document D10, the final packing P is defined by the ratio of the cross-sections of "2223" and the silver matrix and can be determined according to a formula for P given in the paper.
- 3.7 The appellant proprietor submitted that even for the simple case of just two filaments it could be seen that the result of the calculating the parameter P yielded a more complex expression than simply the inverse of the ratio of cross-sectional areas as specified in the claim. Moreover, the value P referred to the packing prior to the process of drawing and rolling, while the ratio referred to in the claim was that obtained in respect of the final wire after it had undergone compression during the drawing process. The change in the relative cross-sections of the silver tube and the superconductor as a result of the rolling and drawing compression could not be predicted with any degree of accuracy. The conclusion that the parameter P of document D10 was simply the reciprocal of the ratio specified in the claim was therefore plainly wrong.

3.8 The board accepts this argument. According to equation 1 in document D10 the overall packing P of a multifilamentary conductor is calculated on the basis of the packing P_i of individual bundles making up the conductor. The individual packing P_i is itself obtained from a ratio in which the denominator is the cross section S_t of the silver tube of the individual bundle. The equation therefore relates neither to the simple ratio defined in claim 1, nor to its inverse. Therefore, the inverse of the values in document D10 for P of between 0.05 and 0.9 cannot destroy the novelty of the ratio claimed. Hence the subject matter of claim 1 is new, both in the case of the main request, where the claimed ratio is not more than 3, and in the case of the auxiliary request, where the claimed ratio is limited to between 1.5 and 2.

4. *Inventive step*

4.1 The claimed ratio of not more than 3 for the main request, and between 1.5 and 2 for the auxiliary request, is the only feature which distinguishes the claimed invention from the disclosure in document D10.

4.2 The arguments put forward by the appellant proprietor to show that the parameter P of document D10 is not the inverse of the ratio claimed include an example of a two-filament wire. Before compression, for a wire with two superconducting filaments enclosed in a circular tube, the cross-sectional ratio is 2. If the parameter P were the inverse of this ratio, its value would be 0.5. From Figure 1 of document D10 it is apparent that rolling increases the density of the superconductor from about 3.3g/cm^3 to about 5g/cm^3 . The appellant

proprietor argues that if one accepts the increase in density of the superconductor, the reciprocal value of P after compression would be 3.4, that is, outside even the range claimed in the main request.

4.3 Using the same example as a basis, the respondent opponent pointed out that a wire with two filaments falls within the claim. Moreover, although even if the parameter P was not simply the inverse of the ratio claimed, the example given by the appellant proprietor showed that a high value of P ($P=0.9$) corresponded to a low value for the ratio (about 1.11), and a low value for P ($P=0.05$) to a high value (about 20 to 30) for the ratio claimed. Also, the compaction from about 3.3g/cm^3 to about 5g/cm^3 corresponded to a volume change of about 66%. In the terms of the claimed ratio of cross-sections, the corresponding change for a two-filament wire was therefore only about 76%. Thus, even if final packing in document D10 did not mean the packing after rolling as in the patent, the factor of compaction was less than 2. Contrary to the appellant proprietor's argument, the practical effect of compression during drawing and rolling was hence not such as to destroy the demonstrated relationship between the parameter P and the ratio claimed in claim 1 of both the main and the auxiliary request.

4.4 Document D10 thus teaches the skilled person that the ratio between superconductor and silver, referred to as ratio in claim 1 and expressed in document D10 in terms of the parameter P, is of great importance for the properties of the superconductor. It also informs the skilled person that a dense distribution of "2223" filaments, corresponding to a large parameter P, is

more suitable for high overall critical current density. Last but not least, it is known from document D10 that the process of forming a multifilamentary conductor by repeatedly packing individual wires into the form of bundles followed by rolling, a technique stated to be known *per se* from low T_c superconductors, leads to an improvement in the mechanical strength of the conductor.

4.5 There is no indication anywhere in the patent that the inventors attempted to achieve anything other than to increase the critical current and the strength of the superconductor, which are the same aims as those to which document D10 addresses itself. In addition, there is no indication in the patent that anything unexpected happens at the upper limit 3 of the ratio claimed in claim 1 of the main request, nor at the boundary of the narrower range of 1.5 to 2 claimed in claim 1 of the auxiliary request. Table 1 of the patent merely shows a progressive increase in the critical current, from a critical current of 1A at a silver ratio of 10 to a value of 20A for a silver ratio of 4 to a value of 38A for a silver ratio of 2. No figures are given for the upper limit 3 of the ratio as claimed in claim 1 of the main request.

4.6 It is the board's judgement that D10 contains clear instructions for the skilled person to achieve the inherently desirable aim of improving the critical current density of a wire of an oxide superconductor by choosing a high value of P, that is, a value of P at or near 0.9. A high value of P of this order corresponds to a low value of the order of 3 or less for the ratio that is claimed in claim 1 of both the main and the auxiliary request. There is no indication anywhere in

the patent of an unexpectedly large increase, over and above the general trend towards higher critical current with lower silver ratio, at a silver ratio of 3 or at any other particular value of the ratio. The upper limit of 3 claimed in claim 1 of the main request therefore constitutes no more than an arbitrary limitation, which is obvious in the light of the disclosure in document D10 of the need for using a wire having a high value of P.

4.7 Claim 1 of the auxiliary request limits the range of the superconductor to silver ratio to the range of 1.5 to 2. The description mentions that the ratio is preferably in the range of 1.5 to 2, but no reason is given for this particular choice of range. Table 1 of the patent which illustrates the steady increase of critical current with decreasing silver ratio does not contain any data below a silver ratio of 2. The claimed ratio must therefore be considered an arbitrary limitation. Moreover, absent any surprising effects associated with choosing a conductor with a ratio falling within those limits, the benefits of choosing a ratio at or below 2 must also be considered obvious, given the clear indication in document D10 that conductors with a high value of P are more suitable for high critical currents.

4.8 For the foregoing reasons the board concludes that the inventions claimed, respectively, in claim 1 of the main request and claim 1 of the auxiliary request, do not involve an inventive step within the meaning of Article 56 EPC.

5. *Apportionment of costs*

5.1 Document D10 was admitted into the proceedings by the opposition division. The decision of the opposition division was based on it.

5.2 The appellant proprietor has withdrawn the objection of not being filed in due time in respect of document D10. The decision of the board concerning the question whether the invention as claimed involves an inventive step is also based on the disclosure in document D10.

5.3 Hence there is no reason to consider an apportionment of costs equitable within the meaning of Article 104 EPC.

Order

For these reasons it is decided that:

1. The appeal is dismissed.
2. The request for apportionment of costs is refused.

Registrar

Chair

S. Sánchez Chiquero

R. G. O'Connell