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D E C I S I O N
of 28 November 2001

Case Number: T 0371/99 - 3.5.2

Application Number: 92104807.0

Publication Number: 0504895

IPC: H01B 12/00

Language of the proceedings: EN

Title of invention:
Superconducting wire using oxide superconductive material

Patentee:
SUMITOMO ELECTRIC INDUSTRIES, LIMITED

Opponent:
Siemens AG

Headword:
-

Relevant legal provisions:
EPC Art. 123(2)

Keyword:
"Amendments -added subject-matter (yes) - arbitrary combination of ranges"

Decisions cited:
G 0009/91, G 0010/91, G 0001/93

Catchword:
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Case Number: T 0371/99 - 3.5.2

D E C I S I O N
of the Technical Board of Appeal 3.5.2
of 28 November 2001

Appellant: (Opponent)
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Decision under appeal: **Interlocutory decision of the Opposition Division of the European Patent Office posted 15 October 1999 concerning maintenance of European patent No. 0 504 895 in amended form.**

Composition of the Board:

Chairman: W. J. L. Wheeler
Members: F. Edlinger
B. J. Schachenmann

Summary of Facts and Submissions

I. The opponent filed this appeal against the interlocutory decision of the opposition division concerning maintenance of European patent No. 504 895 in amended form.

II. Claim 1 of the patent as granted had the following wording:

"A tape shaped high temperature superconducting wire (1) having a plurality of oxide superconductor filaments (2) disposed in a stabilizing material (3), characterized in that

said oxide superconductor filaments (1) have equal thickness and are uniformly distributed over the cross-section of the wire,

the thickness of each oxide superconductor filament (2) is between 5% and 10% of the thickness of the wire (1), and the superconducting properties of said wire remain at least 85% of the original critical current density when being subjected to a bending strain of 0,3% for 200 times."

III. Opposition against the patent as a whole was filed on the grounds that the subject-matter of the opposed patent did not involve an inventive step (Article 100(a) EPC) and that the patent did not disclose the invention in a manner sufficiently clear and complete for it to be carried out by a person skilled in the art (Article 100(b) EPC). Subsequently to the filing of amended claims, in which "between 5% and 10%" in claim 1 as granted was replaced by "above

5% but below 10%", the opponent raised an objection under Article 100(c) and 123(2) EPC against the amendment "above 5%" (letter dated 5 July 1999, page 2, point 1), but did not maintain this objection in the oral proceedings before the opposition division (see minutes of these proceedings, page 1, and points V and VII of the decision under appeal).

IV. Claim 1 of the main request, which the opposition division in the decision under appeal found to meet the requirements of the Convention, is worded as follows:

"A tape shaped high temperature superconducting wire (10) having a plurality of oxide superconductor filaments (5) disposed in a stabilizing material (6),

said oxide superconductor filaments (10) having equal thickness and being uniformly distributed over the cross-section of the wire, and

the thickness of each oxide superconductor filament (5) being above 5% but below 10% of the thickness of the wire (10),

characterized in that

the superconducting properties of said wire remain at least 85% of the original critical current density when being subjected to a bending strain of 0,3% for 200 times."

Claim 2 is dependent on claim 1 and specifies that "said wire (10) has at least 36 oxide superconductor filaments (5)".

V. The reasons set out in the decision under appeal may be summarized as follows:

The opponent no longer contested the amendments. Pages 8 and 9, bridging paragraph, and claim 2 of the application as filed disclosed a thickness of each superconductor of approximately 10% or less than the thickness of the wire, and more preferably, 5% or less than the thickness of the wire. The thickness ratio of "above 5% but below 10%" specified in claim 1 constituted a delimitation against document D2 (EP-A-0 449 316, page 2, lines 33 to 41), which disclosed a thickness of the superconductors of "not more than 5%" of the thickness of the wire.

Claim 1 of the opposed patent related to a newly found technical effect of achieving a critical current density of at least 85% of the original critical current density even after the wire was subjected to a bending strain of 0,3% for 200 times. The description, in particular tables 2 to 4, of the patent specification disclosed two embodiments for achieving this effect (No. 2: 90% and No. 3: 85%). In view of this disclosure, the person skilled in the art could easily find, by routine trial and error, new but equally useful variants of the invention with a remaining critical current density of at least 85%. This minimum value of 85% would implicitly depend on the various parameters and process steps disclosed in the context of tables 2 to 6 of the patent specification and could be easily tested. It thus constituted a functional feature providing information which was sufficiently clear for achieving the found effect, rather than merely defining an underlying technical problem.

This functional definition was justified by the technical contribution of the opposed patent to the art, in particular that disclosed in D2, which constituted prior art according to Article 54(2) EPC because the opposed patent was not entitled to a priority date. D2 suggested that the thickness ratio should be made not more than 5%. Even though the superconducting wire disclosed in the opposed patent was subjected 200 times to the same bending strain, and not only once as in D2, the remaining critical current density was superior with a range of thickness ratios as claimed in the opposed patent. The subject-matter of the opposed patent was therefore inventive.

VI. With a letter dated 26 October 2001, the respondent proprietor filed amended claims and description pages for four auxiliary requests.

Claim 1 of each of the auxiliary requests 1 to 4 specifies, *inter alia*, the same ranges of thickness of each superconductor "above 5% but below 10% of the thickness of the wire" and "at least 85% of the original critical current density".

VII. Oral proceedings were held before the Board on 28 November 2001.

VIII. The appellant opponent requested that the decision under appeal be set aside and that the European patent No. 504 895 be revoked, and argued essentially as follows:

The opposed patent did not disclose the invention in a manner sufficiently clear and complete for it to be carried out by a person skilled in the art

(Article 100(b) EPC). Superconducting properties of the wire which remained at least 85% of the critical current density as specified in the respective characterising portions of claim 1 of all the requests did not constitute features which provided a technical effect but merely specified test parameters which amounted to an obvious desideratum in the art of superconducting wires, namely a high critical current density even after a large number of bending actions. The optimum behaviour, of course, would be a critical current density that remained unchanged, ie 100% of the original critical current density, when subjected to bending. The opposed patent only disclosed two examples (No. 2 and 3 in tables 2 to 4) which constituted embodiments of the claimed subject-matter, and only disclosed specific structural parameters and manufacturing steps for these two embodiments. However, the description did not allow the skilled person to generalise these specific features, in particular it did not disclose which of these specific features, alone or in combination, were essential for achieving a critical current density which remained at least 85% with a thickness ratio of the filaments of above 5% but below 10%. The general disclosure of the opposed patent only referred to equal thickness and distribution of the filaments, and a part of the original description emphasized that the best results were obtained with a thickness ratio of "5% or less". The superconducting properties set out in the characterising portion of claim 1 of all the requests thus did not constitute functional features of a superconducting wire which were sufficiently supported by the description.

The arbitrary parameter deduced from one specific example ("at least 85%") in combination with the

disclaiming of the preferred range of "5% or less" constituted subject-matter which extended beyond the content of the application as filed (Article 100(c) and Article 123(2) EPC) in that it completely distorted the original disclosure. If this change were allowed it would create legal uncertainty because the person skilled in the art would normally follow the guidance of the general disclosure and the specific examples of a patent application. In the application as filed, the skilled reader found that a thickness ratio of "5% or less" was the preferred range. This was supported by the examples of tables 2 to 6 which showed a general tendency: the lower the thickness ratio the higher the percentage of the remaining critical current density. There was, however, no disclosure in the application as filed for a range of thickness ratios above 5% and below 10% which had the superconducting properties as specified in the characterising portion of claim 1 as now claimed, but only one specific example (No. 3 of tables 2 and 4) which had an arbitrary number of filaments (sixty) and properties resulting from the specific manufacturing process. Allowing the superconducting wires to be defined on the basis of this specific and arbitrary measurement value of 85% of the original critical current density would mean granting protection for an extremely large range of superconducting wires, covering wires having the disclosed property and any better ones in exchange for insufficient information.

The preferred range of the application as filed was disclaimed in the examination proceedings because D2 had then been considered as a document falling under Article 54(3) EPC. In the opposition proceedings, it was found that the opposed patent did not validly claim

a priority date. D2 thus had to be considered as prior art according to Article 54(2) EPC and, in view of the fact that it contained essentially the same teaching, did not constitute an accidental novelty-destroying disclosure but represented the closest prior art for the assessment of inventive step. In these circumstances, a disclaimer could not be allowed since, in accordance with constant jurisprudence of the EPO, a disclaimer was only allowed if the cited document had no relevance for any further examination of the claimed invention.

The objection of extended subject-matter had already been raised in the opposition proceedings. Therefore, it did not constitute a fresh ground for opposition in the meaning of G 10/91 (OJ EPO 1993, 420) and should be dealt with in the appeal proceedings.

Claim 1 of the opposed patent, when correctly construed, did not define inventive subject-matter. Since it was not clear which of the specific features of the two embodiments were essential for obtaining the superconducting properties specified in the characterising portion of claim 1, they had to be disregarded when judging inventive step of the generalised range of claim 1. The remaining difference with respect to the disclosure of D2 was then the specification of a *desideratum*: namely wires with a low reduction in critical current density, so that it remained at least 85% after the wire had been bent 200 times. This specification of a desired range of properties was obvious from the teaching of D2, which had the same general objective of achieving a low reduction in critical current density when the wire had been subjected to the same bending strain, and

suggested the same preferred range of thickness ratios (less than 5%). The mere fact that the disadvantage of a slightly higher reduction in critical current density (to 85%) was accepted in a less preferred range of thickness ratios did not mean that a prejudice was overcome. The respondent's argument that the higher absolute values of critical current density disclosed in the opposed patent resulted from uniformly distributing the superconductor filaments over the cross-section of the wire was not correct. There was no difference, in this respect, between the wire as claimed and the wire disclosed in D2. Higher values of critical current density were generally obtained by modifying parameters of the manufacturing process, such as applying a higher pressure to cause deformation and more uniform orientation of powder particles.

IX. The respondent proprietor requested that the appeal be dismissed, or that the patent be maintained in amended form in accordance with the auxiliary requests 1, 2, 3 or 4 filed with letter dated 26 October 2001. The respondent's arguments may be summarized as follows:

The objection that the European patent extended beyond the content of the application as filed constituted a new ground for opposition which was not put forward until the appeal stage because the objection raised in the opposition proceedings only concerned the feature specifying a thickness ratio of "above 5%", whereas now the appellant alleged that the features of the characterising portion of claim 1 constituted unallowable amendments. Referring to jurisprudence of the EPO, in particular that developed by the Enlarged Board in G 9/91, OJ EPO 1993, 408, point 18, and G 10/91 (*loc cit*), the respondent requested not to

(re-)introduce this ground for opposition into the appeal proceedings.

Even if this ground was introduced into the appeal, it was not relevant because all the features were explicitly disclosed in the application as filed. A thickness ratio of "approximately 10% or less" was mentioned in several passages of the application as filed. There was only one passage referring to a thickness ratio of less than 5% which said: "More preferably, the decrease of critical current density by bending can further be suppressed by making the thickness of the superconductor 5% or less than the thickness of the wire." (page 8, line 15 to page 9, line 4, of the application as filed which corresponds to page 3, line 54 to page 4, line 2, of the patent specification). However, taken in the context of the application as a whole, in particular the examples of table 4, this did not mean that values below 5% were the most favourable. It only meant that "the decrease" (in percentage) could be further reduced. The examples No. 2 to 4 in table 4 all had thickness ratios above 5% but below 10% and had the highest (absolute) values of critical current density among the six examples of table 4. The disclosure of "approximately 10% or less" and the explicit mention of a value of 5% implicitly disclosed a sub-range "above 5% but below 10%" (in addition to the sub-range of "5% or less").

The features of the characterising portion of claim 1 of the main request were also explicitly disclosed in the context of the examples No. 2 and 3 of table 4. Both examples had thickness ratios above 5% but below 10%. Example No. 3, having a value of 85% of the original critical current density, disclosed the lower

limit of the range "at least 85%", and example No. 2 also had at least 85% (ie 90%) of the original critical current density.

The range of thickness ratios of "above 5% but below 10%" was not merely a limiting feature for distinguishing the subject-matter of claim 1 from the prior art disclosed in D2. The inventors had realized for the first time that these thickness ratios were most advantageous. If the thickness of the filaments was reduced, portions of filaments might be disproportionately increased or reduced in thickness, thereby leading to degradation of the filaments as a whole. Therefore, to increase the thickness ratios above 5% had two counteracting effects. On the one hand, it was easier to suppress the generation of degraded portions. On the other hand, the effect of strain on bending became greater with increasing thickness ratios. In combination with the other features of claim 1, in particular the feature specifying filaments of equal thickness which were uniformly distributed over the cross-section of the wire (in its finished state and not only before the deformation steps), the claimed superconducting wire had properties as specified in the characterising portion of claim 1 which none of the prior art superconducting wires could achieve.

The characterising portion of claim 1 of the main request specified a functional feature which was permissible in the present case because, in view of the embodiments in the description, the result which was aimed at could be achieved by known process steps and without undue burden, and it was sufficiently clear and straightforward how it could be tested whether or not a

superconducting wire obtained in this way had the properties as specified in claim 1. The functional feature thus was not a mere specification of desired superconducting wire characteristics of previously unknown low reduction of the original critical current density by bending, but was based on embodiments which were made available (examples No. 2 and 3) with known parameters and process steps and embraced other readily available means to be found in the future. Therefore, it was not possible to define the invention more precisely without unduly restricting the scope of the invention.

The subject-matter of claim 1 was not obvious from the prior art because D2 disclosed a range of thickness ratios below 5% and thus led away from the present invention. The examples of D2 which had higher thickness ratios all had values of remaining critical current density which were lower than 85% of the original critical current density although the wire had been bent only once with the same bending strain before the measurements were carried out. The authors of D2 did not realize that better results could be obtained with thickness ratios above 5% but below 10% when the filaments had equal thickness and were uniformly distributed in the finished superconducting wire. The uniform distribution could, for example, be achieved by preparing a stabilizing material having a plurality of communicating holes formed at equal spacing, forming an oxide high temperature superconductor in the plurality of holes in the stabilizing material, and then applying plastic working thereto (page 2, line 54 to page 3, line 1 of the patent specification). If a uniform distribution was obtained in this way (or by careful drawing of bundled filaments), the resulting

superconducting wire had a high critical current density which remained high even after bending the wire 200 times under the specified strain conditions.

Reasons for the Decision

1. The appeal is admissible.

2. The respondent referred to the decision G 9/91, point 18, and the opinion G 10/91 and objected to what he considered to be a (re-)introduction of a fresh ground for opposition in the appeal proceedings. G 9/91 and G 10/91 refer to the extent of obligation and power to examine grounds for opposition, in particular the power of a board of appeal to examine grounds for opposition on which the decision of the opposition division has not been based (G 9/91, point 18). However, G 9/91, point 19, makes clear that this does not apply to amendments of the patent, stating: "In order to avoid any misunderstanding, it should finally be confirmed that in case of amendments of the claims or other parts of a patent in the course of opposition or appeal proceedings, such amendments are to be fully examined as to their compatibility with the requirements of the EPC (e.g. with regard to the provisions of Article 123(2) and (3) EPC)."

3. In the opposition proceedings leading to this appeal, the opposed patent was amended in response to grounds for opposition under Article 100(a) and (b) EPC, and an objection that the amendments made by the proprietor infringed Article 123(2) EPC was raised by the opponent (see point III above). The question of the allowability of the amendments was also dealt with in the decision

under appeal (see point V above), which was taken pursuant to Article 102(3) EPC, ie "taking into consideration the amendments made by the proprietor of the patent during the opposition proceedings, the patent and the invention to which it relates meet the requirements of this Convention".

4. The respondent correctly set out that other aspects of the amendments of claim 1 were objected to in the opposition than in the present appeal proceedings. However, the legal basis under consideration is the same and the effect of the amendments has to be considered as a whole, since it has to be examined whether the European patent has been "amended in such a way that it contains subject-matter which extends beyond the content of the application as filed" (Article 123(2) EPC).

5. For these reasons, the appellant's objections to inadmissible amendments of claim 1 of the opposed patent do not constitute a fresh ground for opposition which may be considered in appeal proceedings only with the approval of the patentee, as held in G 9/91 and G 10/91.

6. *Main request*

6.1 Claim 1 of the main request specifies a superconducting wire having superconductor filaments with a thickness of "above 5% but below 10% of the thickness of the wire" and superconducting properties which remain "at least 85% of the original critical current density...".

6.2 A thickness ratio of less than 10% is disclosed in several passages of the application as filed (eg

description, page 4, lines 11 to 14 and lines 21 to 25). Furthermore, the application as filed explicitly refers to a sub-range of "5% or less" in the context of "more preferably, the decrease of critical current density by bending can further be suppressed by making the thickness of the superconductor 5% or less than the thickness of the wire" (page 9, lines 1 to 4).

6.3 One specific example (No. 3) of a superconducting wire is disclosed in the context of tables 2 to 4 of the application as filed which was measured to have 85% of the original critical current density after it had been subjected to a bending strain of 0,3% for 200 times. The lower limit value of the range (85%) of the (remaining) critical current density as specified in the characterising portion of claim 1 was achieved in this example with a wire having a thickness ratio of 6.6% (see table 2, No. 3). A higher value (90%) was achieved with a wire having a thickness ratio of 5.4% (example No. 2) and a still higher value was achieved with a wire having a thickness ratio of 4.0%, which is outside the claimed range (example No. 1). Another example within the claimed range of thickness ratios (8.6%) only achieved 82% of the original critical current density (example No. 4).

6.4 The wire of example No. 3 was obtained by bundling 60 oxide superconductor filaments and was manufactured from powder of a specific composition, thermally treated to obtain a specific mixture of superconducting phases, filled in a specific tube, mechanically worked and thermally treated again (see page 16, line 16 to page 20, line 20).

6.5 The examples No. 1 to No. 4 are presented as individual

embodiments of a preferred range of thickness ratios of "not more than 10%" (cf original claims 2, 5, 7, 12 and 13). The critical current density (B) (expressed as a percentage of the value before bending 200 times with a bending strain of 0.3%) decreases monotonically with increasing thickness ratio down to a value of 82% with the highest thickness ratio (8.6%) within the claimed range (example No. 4). Examples No. 5 and No. 6 (thickness ratios: 12% and 20%; see table 2) are said to indicate "a further significant decrease of Jc" (51% and 44%; page 20, table 4 and lines 10 to 20). This explains the statement on page 9, lines 1 to 4, of the application as filed: "More preferably, the decrease of critical current density by bending can further be suppressed by making the thickness of the superconductor 5% or less than the thickness of the wire."

6.6 Another fact which which can be extracted from table 4, is that example No. 4 with a remaining critical current density of 82% outside the range specified in claim 1 has the highest absolute value of critical current density ($1.64 \times 10^4 A/cm^2$) under the given bending strain conditions.

6.7 The application as filed therefore discloses one specific example (example No. 3 in table 4) for which superconducting properties corresponding to the lower limit value of the range (85%) have been measured under specific manufacturing conditions including a specific thickness ratio (6.6%, an arbitrary value within the range of thickness ratios specified in claim 1) and other process parameters which would have an influence on this measured value. But the application as filed does not contain any general teaching linking the

particular value of the remaining critical current density of example No. 3 with the range of thickness ratios "above 5% but below 10%". Both the example No. 1 with the highest percentage of remaining critical current density (94%) and the example No. 4 with the highest absolute value of critical current density ($1.64x10^4 A/cm^2$) are either outside the range of thickness ratio or do not have the superconducting properties specified in the claim. Claim 1, which combines an arbitrary measured value of the superconducting properties with a sub-range of a particular structural parameter (thickness ratio) of the superconducting wires which was not presented as a preferred range in the application as filed, specifies subject-matter which extends beyond the content of the application as filed, in contravention of Article 123(2) EPC.

6.8 Furthermore, the amendments to Claim 1 may not be considered as relating to an undisclosed technical feature which merely limits the scope of protection of claim 1 as granted with respect to accidental prior art, because, as can be seen from the arguments presented by the parties, and in particular the proprietor, the amendments define a new compilation of parameters which is not to be considered as merely excluding protection for part of the subject-matter of the claimed invention. On the contrary the amendments define limiting features which provide a technical contribution to the art disclosed in D2, which undisputedly constitutes the closest prior art for the assessment of inventive step and does not constitute an accidental disclosure in an unrelated field of technology. Such amendments are not allowable under Article 123(2) EPC because they would give the

proprietor an unwarranted advantage, namely protection for something which was not properly disclosed and maybe not even invented on the date of filing of the application (see decision G 1/93, OJ EPO, 1994, 541, points 9, 12 and 16).

7. *Auxiliary requests 1 to 4*

Since claim 1 of each of the requests contains the above undisclosed combination of ranges of thickness ratios and superconducting properties, and the added features of the auxiliary requests cannot remove this deficiency, claim 1 of each of these requests likewise infringes Article 123(2) EPC.

8. Given that, for the above reasons, the patent cannot be maintained in any of the forms requested, the Board need not consider the other objections.

Order

For these reasons it is decided that:

1. The decision under appeal is set aside.

2. The patent is revoked.

The Registrar: The Chairman:

M. Hörnell W. J. L. Wheeler