

Internal distribution code:

- (A) Publication in OJ
(B) To Chairmen and Members
(C) To Chairmen
(D) No distribution

**Datasheet for the decision
of 12 April 2011**

Case Number: T 1531/08 - 3.5.02

Application Number: 00987982.6

Publication Number: 1247324

IPC: H02K 55/04

Language of the proceedings: EN

Title of invention:

Exciter and electronic regulator for superconducting rotating machinery

Patentee:

American Superconductor Corporation

Opponent:

Siemens Aktiengesellschaft

Headword:

-

Relevant legal provisions:

EPC Art. 56

Relevant legal provisions (EPC 1973):

-

Keyword:

"Inventive step - yes"

Decisions cited:

-

Catchword:

-



Case Number: T 1531/08 - 3.5.02

D E C I S I O N
of the Technical Board of Appeal 3.5.02
of 12 April 2011

Appellant: Siemens Aktiengesellschaft
(Opponent) Postfach 22 16 34
D-80506 München (DE)

Representative: -

Respondent: American Superconductor Corporation
(Patent Proprietor) Two Technologie Drive
Westborough, MA 01581-1727 (US)

Representative: Barth, Stephan Manuel
Reinhard, Skuhra, Weise & Partner GbR
Patent- und Rechtsanwälte
Friedrichstrasse 31
D-80801 München (DE)

Decision under appeal: Interlocutory decision of the Opposition
Division of the European Patent Office posted
5 June 2008 concerning maintenance of European
patent No. 1247324 in amended form.

Composition of the Board:

Chairman: M. Ruggiu
Members: R. Lord
P. Mühlens

Summary of Facts and Submissions

- I. This is an appeal of the opponent against the interlocutory decision of the opposition division concerning the European patent No. 1 247 324 that, account being taken of the amendments made by the patent proprietor, the patent and the invention to which it related met the requirements of the EPC.
- II. The following documents of the state of the art played a role in the appeal proceedings:
- B: US 5 965 959 A;
D: US 4 659 973 A; and
E: English language abstract of JP 63 310 366 A.
- III. In a letter dated 11 March 2011 the respondent requested that the appeal be dismissed, or if that was not possible, that the patent be maintained in amended form on the basis of one of the auxiliary requests I to V filed with that letter.
- Oral proceedings before the board took place on 12 April 2011, at which only the respondent's main request was discussed.
- The appellant (opponent) requested that the decision under appeal be set aside and that the patent be revoked.
- The respondent (patent proprietor) requested that the appeal be dismissed.

IV. Claim 1 of the respondent's main request reads as follows:

"An exciter assembly for supplying power to a superconducting load (102) comprising a transformer (106) having a primary winding (108; 212) and a secondary winding (112; 208); wherein said superconducting load (102) is disposed within a cryogenic region of a rotating machine; wherein one (112; 208) of the primary and secondary windings being positioned in a rotating reference frame relative to the other (108; 212) of the primary and secondary windings; characterized in that it further includes a sensor which provides a control signal indicative of the flow of a field excitation current to the superconducting load (102); it further includes a current regulator which is disposed in the rotating reference frame and, on the basis of the control signal, regulates the field excitation current to a predetermined set; and the current regulator is disposed in a non-cryogenic environment."

Claims 2 to 8 are dependent on claim 1.

V. The arguments of the appellant which are relevant to the present decision are essentially as follows:

Document D represented the closest prior art. The skilled person, wishing to decrease the physical size of such a known machine, without decreasing its power (for instance as a ship's motor), would have considered it obvious to modify it to make use of a

superconducting winding, since these were well-known in the technical field, as illustrated by document B. He would therefore have replaced the conventional field winding of document D with superconducting material, and modified the remainder of the machine accordingly. He would thus have arrived in an obvious manner at an assembly according to claim 1 of the respondent's main request, in particular since document D disclosed that the current regulator is in a non-cryogenic environment. Therefore the subject-matter of this claim did not involve an inventive step according to Article 56 EPC.

Document E could also be considered as a starting point for the assessment of inventive step, in which case the skilled person would have considered it obvious to apply the teaching of document B to the rotating machine of that document, thus positioning the current regulator in the rotating frame. The further feature of claim 1 of the respondent's main request, namely that the current regulator is placed in a non-cryogenic environment, did not result in the presence of an inventive step, firstly because this was in effect a negative feature, and secondly because it represented only the obvious selection of one of two possible alternatives, which in the light of the teaching of column 6, lines 8 to 22 of document B was to be considered as a simple trade-off.

VI. The relevant arguments of the respondent can be summarised as follows:

The document D did not represent an appropriate starting point for the assessment of inventive step of

the claimed subject-matter, because unlike the invention of the patent in suit it did not relate to superconducting machines. This distinction implied many differences beyond just replacing the material of the winding, such as the installation of a cryogenic chamber with its ancillary equipment, and the adaptation of the control circuitry to the entirely different characteristics of the superconducting winding. Moreover it involved the consideration of entirely new technical problems, such as heat leakage through the wiring into the cryogenic chamber.

The definition of the position of the current regulator in a non-cryogenic environment was not a negative feature, but instead specified the position of a positively defined element. Moreover, whether starting from document D or document E in combination with document B, this could not be considered as a trivial selection between two equivalent alternatives, firstly because document B taught explicitly that the current regulator should be positioned in the cryogenic environment in order to reduce the on-resistance of the MOSFETs, and secondly because the combination of different advantages arising from the claimed selection, as described in paragraph [0036] of the patent in suit, would not have been apparent to the skilled person from the prior art.

Reasons for the Decision

1. The appeal is admissible.

2. The novelty of the subject-matter of claim 1 of the patent in suit is not in dispute.

3. The appellant's main objection concerning inventive step is based on the selection of the document D as the starting point for the argument.
 - 3.1 The board notes that the appellant's arguments in this respect are only correct to the extent that he argues that document D relates to the same general technical field (rotating electric machines) as the patent in suit, and that this document and the present claim 1 have a significant number of features in common. However, in the board's opinion, this argumentation overlooks the fact that document D does not concern the type of device defined in the generic opening paragraph of the present claim 1, i.e. an "*exciter assembly for supplying power to a superconducting load*", because document D relates to a motor using conventional conductors. The board agrees with the respondent that this difference implies that the claimed assembly differs from that of document D in a number of significant aspects which are not explicitly defined in the claim, beyond the mere replacement of the conventional conducting material of the load with a superconducting material. These aspects include the provision of a cryostat to house the superconducting load and the associated cooling apparatus, the adaptation of the construction to minimise heat leakage into the cryostat, the replacement of the SCR's which drive the load of document D with devices appropriate to superconducting systems, and the replacement of the control system of the conventional synchronous motor, in which the windings are driven essentially

continuously, with the entirely different control system for a superconducting load, which operates without drive in the persistence mode for the majority of the time, and is driven in the ramping mode only when the machine is first started and intermittently thereafter.

3.2 The board therefore concludes that if a skilled person working with the machine of document D were to decide that, in order to provide comparable power in a smaller space (for instance when the machine is a motor in a ship), he should replace that machine with one using superconducting windings, he would not simply replace the conventional winding in the machine of document D with a superconducting one, and then make the necessary adaptations of the remainder of the machine (as argued by the appellant), but would instead, when taking into account that those adaptations were of an extensive nature, and that rotating electric machines with superconducting windings were already known at the priority date of the patent in suit, have put document D aside and started from a document describing such a superconducting machine.

4. Document E describes (see the section "Purpose") a rotating electric machine having a superconducting field winding to which current is fed through a rotary transformer. The board therefore agrees with the decision under appeal (and with the respondent) that this document represents the most promising starting point for the assessment of inventive step.

4.1 It is not disputed that document E describes a device according to the preamble of claim 1 of the

respondent's main request. The assembly of that claim is thus distinguished from this known device by the features of the characterising part of the claim, namely

- (a) the provision of a sensor providing a signal indicative of the current in the superconducting load,
- (b) the provision in the rotating part of the machine of a current regulator for regulating current in the superconducting load on the basis of the signal from the sensor, and
- (c) that the current regulator is in a non-cryogenic environment.

4.2 The document B also relates to the technical field of excitation of superconducting windings, and describes in particular in column 6, lines 8 to 22, that it is advantageous in such a device to provide the current to the superconducting windings by means of MOSFETs disposed in the cryogenic region, as depicted in Fig. 2 of that document. The skilled person would recognise that this advantage would apply also to the rotating machine of document E, and would therefore consider it obvious to modify that machine accordingly. This modification would result in the current regulator (i.e. the MOSFETs which switch the current) being disposed in the cryogenic region of the machine of document E, and thus automatically in the rotating part of the machine. That a current sensor would also be required to provide a control signal would be self-evident, and is confirmed by column 7, lines 64 to 67 of document B. The board thus sees no reason to deviate from the conclusion in the decision under appeal that the combination of the features of the preamble of the

present claim 1 with features (a) and (b) identified above would be obvious to the skilled person.

- 4.3 However, as noted in the previous paragraph, document B explicitly teaches that the current switching MOSFETs (i.e. the current regulator) must be in the cryogenic region in order to achieve the desired effects, and thus teaches directly away from feature (c) identified above. As described in paragraph [0036] of the patent in suit, this feature results in a number of advantages, specifically enabling the use of higher voltage semiconductor devices such as IGBTs (thus avoiding the reduced operating voltage rating of cryogenically cooled MOSFETs described in paragraph [0026]), reduced complexity because the array of MOSFETs can be replaced by a large power block, reduced power dissipation in the cryogenic region, and easier repair and maintenance of the switching devices and associated circuitry. The board notes that these advantages are achieved at the expense of increased losses in the switching transistors, but is not convinced by the appellant's argument that the choice between the two arrangements (i.e. the current regulator being either inside or outside the cryogenic environment) is a trivial selection between two equivalent options, firstly because document B clearly teaches in favour of the former, and secondly because at least some of the advantages arising from the latter, i.e. that now claimed, would not be immediately apparent to the skilled person without prior knowledge of the teaching of the patent in suit. This last point applies particularly with respect to the advantage of enabling the use of higher voltage semiconductor devices, which concerns a significant problem which was not identified

in the prior art. The board therefore concludes that the modification of the arrangement derived from documents E and B described in paragraph 4.2 above to position the current regulator outside the cryogenic environment would not be obvious to the skilled person, and therefore concurs with the decision under appeal that the subject-matter of claim 1 of the respondent's main request involves an inventive step according to Article 56 EPC.

- 4.4 Even if, for the sake of argument, the document D were taken as the starting point, as argued by the appellant, the same conclusion would apply, since also from that starting point, in order to arrive at the claimed arrangement, it is necessary to introduce the teaching of document B regarding the requirements for a superconducting load, so that also in this case it would be necessary to go against the teaching of document B with respect to the positioning of the current regulator. The appellant's argument that, since document D describes an assembly with no cryogenic environment, it automatically discloses the positioning of the current regulator in a non-cryogenic environment is not found convincing, because in the absence of any disclosure of a cryogenic environment in that document, it cannot be considered to provide any teaching regarding the choice as to whether in a device derived from a combination of documents D and B the current regulator should be placed inside or outside the cryogenic environment. Since the wording "*disposed in a non-cryogenic environment*" can be considered as being, in the context of the remainder of the claim, synonymous with "*outside the cryogenic environment*", this has to be understood to be a positive definition

of the position of the current regulator, and not, as argued by the appellant, merely a negative definition.

4.5 Claims 2 to 8 of the respondent's main request are dependent on claim 1, so that the above conclusion concerning inventive step applies also to those claims.

5. Thus, the board comes to the conclusion that the appellant has not presented any convincing arguments as to why the decision under appeal should be set aside. It is therefore not necessary for the board to consider the respondent's auxiliary requests.

Order

For these reasons it is decided that:

The appeal is dismissed.

The Registrar:

The Chairman:

C. Moser

M. Ruggiu