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**Datasheet for the decision
of 25 January 2011**

Case Number: T 0052/09 - 3.2.03

Application Number: 01942409.2

Publication Number: 1248933

IPC: F25B 9/14, H02K 55/04

Language of the proceedings: EN

Title of invention:

Cooling system for high temperature superconducting machines

Patentee:

AMERICAN SUPERCONDUCTOR CORPORATION

Opponent:

CONVERTERTEAM LTD

Headword:

-

Relevant legal provisions:

EPC Art. 56
RPBA Art. 13

Keyword:

"Main request: lack of inventive step"
"Auxiliary requests I and II: not admitted"
"Auxiliary requests III: claims allowable but description to be adapted (remittal)"

Decisions cited:

-

Catchword:

-



Case Number: T 0052/09 - 3.2.03

DECISION
of the Technical Board of Appeal 3.2.03
of 25 January 2011

Appellant:
(Opponent)
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Decision under appeal:
Interlocutory decision of the Opposition
Division of the European Patent Office posted
10 November 2008 concerning maintenance of
European patent No. 1248933 in amended form.

Composition of the Board:

Chairman: U. Krause
Members: Y. Jest
K. Garnett

Summary of Facts and Submissions

I. By its decision dated 10 November 2008 the Opposition Division maintained European Patent No. 1 248 933 in amended form on the basis of an amended claim 1 and of claim 9, corresponding to the granted method-claim 13, having the following wording:

1. "A cryogenic cooling system for cooling a remote thermal load

comprising:

a refrigerator including at least one cryogenically cooled surface and at least one cryogenic fluid transport device disposed within the refrigerator for providing a mechanical force for circulating a heat transfer fluid between the cryogenically cooled surface and the remote thermal load, characterised in that said transport device is a mechanical means whereby the heat transfer fluid is maintained at a single phase by the at least one cryogenically cooled surface, and by further comprising a plurality of cryocoolers, each having a corresponding cryogenically cooled surface, and by further comprising valving to selectively isolate at least one of the plurality of the cryocoolers from remaining ones of the plurality of cryocoolers."

9. "A method of cooling a rotating thermal load using a cryogenically cooled surface, the method being characterised by:

operating a fluid transport device in the form of a mechanical means disposed within the refrigerator to provide the heat transfer fluid to a thermal load in an

initial non- \langle HHY \rangle the heat transfer fluid to a thermal load in an initial non-rotating condition; rotating the thermal load to a sufficient rotational velocity to generate sufficient forces to cause the heat transfer fluid to move toward the rotating thermal load; and wherein in that the heat transfer fluid is maintained at a single phase."

As indicated in the last full paragraph of page 2 of the decision of the opposition division, the words contained in the published text of claim 9 of the granted patent, i.e. the words "*initial non- \langle HHY \rangle the heat transfer fluid to a thermal load in an*", were an obvious printing error and therefore to be left out of any consideration.

The Opposition Division found that the grounds of opposition, namely lack of novelty and inventive step, did not prejudice the maintenance of the patent in this amended form.

II. The opponent, hereinafter the appellant, lodged the appeal on 7 January 2009 and paid the appeal fee on the same day.

The statement of grounds was received on 10 March 2009.

III. In a communication pursuant to Article 15(1) of the Rules of Procedure of the Boards of Appeal (RPBA), annexed to the summons to attend oral proceedings dated 16 September 2010, the Board gave a preliminary assessment of the case.

IV. In the letter of 23 December 2010, the patent proprietor, hereinafter the respondent, filed in reply

an amended set of claims according to a main request and new auxiliary requests I to IV.

- V. During the oral proceedings which took place on 25 January 2011, the parties made the following requests:

The appellant requested that the decision under appeal be set aside and that the European patent No. 1 248 933 be revoked.

The respondent requested that:

- (a) The decision under appeal be set aside;
 - (b) The patent be maintained on the basis of the main request filed with the letter dated 23 December 2010;
 - (c) Document A12 be not admitted into the proceedings but that if it were to be admitted, the case be remitted to the opposition division;
 - (d) Alternatively, the patent be maintained on the basis of auxiliary requests I, II or III filed during the oral proceedings.
- VI. The independent claims of the main request and of the three auxiliary requests have the following wording:

- (a) The main request is identical to the request which was found allowable by the opposition division, wherein the wording of claim 9 has been corrected by deleting the redundant passage (see paragraph I above).

Method-claim 9 of the main request now reads:

9. "A method of cooling a rotating thermal load using a cryogenically cooled surface, the method being characterised by:

operating a fluid transport device in the form of a mechanical means disposed within the refrigerator to provide the heat transfer fluid to a thermal load in an initial non-rotating condition;
rotating the thermal load to a sufficient rotational velocity to generate sufficient forces to cause the heat transfer fluid to move toward the rotating thermal load; and wherein in that the heat transfer fluid is maintained at a single phase."

(b) Independent claims 1 and 9 of the auxiliary request I have the following wording (the changes are shown in bold characters):

1. "A cryogenic cooling system for cooling a remote **superconducting windings** thermal load

comprising:

a refrigerator including at least one cryogenically cooled surface and at least one cryogenic fluid transport device disposed within the refrigerator for providing a mechanical force for circulating a heat transfer fluid between the cryogenically cooled surface and the remote thermal load, characterised in that said transport device is a mechanical means whereby the heat transfer fluid is maintained at a single phase by the at least one cryogenically cooled surface, and by further comprising a plurality of cryocoolers, each having a corresponding cryogenically cooled surface, and by further comprising valving to selectively isolate at least one of the plurality of the cryocoolers from remaining ones of the plurality of

cryocoolers **while allowing continued operation of the system.**"

9. "A method of cooling a rotating thermal load using a cryogenically cooled surface, the method being characterised by:

operating a fluid transport device in the form of a mechanical means disposed within ~~the a~~ refrigerator to provide the heat transfer fluid to a thermal load in an initial non-rotating condition;

rotating the thermal load to a sufficient rotational velocity to generate sufficient forces to cause the heat transfer fluid to move toward the rotating thermal load; ~~and~~ wherein in that the heat transfer fluid is maintained at a single phase; **and further comprising after rotating the thermal load, terminating operation of the fluid transport device.**"

(c) Claim 9 of the auxiliary request II is identical to claim 9 of the auxiliary request I; amended claim 1 of the auxiliary request II reads:

1. "A cryogenic cooling system for cooling a remote **superconducting windings** thermal load ... (as defined in claim 1 of the auxiliary request I) ...; **and wherein the refrigerator is stationary and the remote thermal load rotates relative to the stationary refrigerator.**"

(d) The set of claims of the auxiliary request III is limited to method-claims, wherein claim 1 corresponds to claim 9 of auxiliary request I.

VII. Relevant prior art considered in the appeal proceedings:

A1: US-A- 5 513 498

A4: US-A- 3 473 341

A12: EP-A- 0 690 550

VIII. The arguments presented by the appellant can be summarised as follows:

Document A12 cited with the grounds of appeal should be allowed into the proceedings. Compared to the method claim of the main request, the disclosure of A12 is of higher relevance than the state of the art chosen by the opposition division as starting point.

(a) Main request

A12 discloses a method for cooling rotating thermal loads by using a gaseous coolant which may be pumped by adequate mechanical means to be circulated within the cooling system (column 6, lines 39 to 45).

Furthermore, the skilled person recognises that a certain degree of self-pumping of the coolant is automatically achieved due to the construction of the apparatus shown in A12 and because of the following consideration. First, centrifugal forces are applied to the coolant due to the geometry or arrangement of the rotating coolant pipes; second, a local warming up of the coolant in the region of heat-transfer with the thermal load generates thermal and density gradients of the coolant circulating within the system. Accordingly the coolant in the region of the thermal load pushes the coolant in the cold region of the cryocooler. As a result, the coolant is circulated also by some pumping

forces, even if these might be very small as compared to the power provided by the mechanical pump. The difference as regards the claimed method of the main request would thus merely consist in locating the mechanical pumping means inside the refrigerator, which is however known per se from A4 and obviously applicable to A12.

Document A4 discloses the closest prior art for a cryogenic cooling system for cooling a remote thermal load. The claimed system differs from A4 in that it comprises a plurality of cryocoolers each with a cooled surface and valving means to connect selectively some of these cryocoolers. A hint for using several cryocoolers in a cooling system is given in column 6, lines 34 to 36 of A1. Further, the person skilled in the art knows that reliability in a system can be improved by duplicating its crucial components. This, applied to the current case, would mean providing more than a single cryocooler. Since some of these cryocoolers will not be used in normal operating mode but only be connected to the system in case of failure of an active cooler, it is an immediate additional step to provide valving means in order to selectively control the cooler(s) in use.

(b) Auxiliary requests I to II

There is no reason justifying the submission of amendments to claim 1 according to these auxiliary requests at such a very late stage, namely during the oral proceedings. The additional features in claim 1 of these auxiliary requests define merely the thermal load, which does not belong to the claimed cooling system as

such. These features thus do not add any limitation to the system and cannot prima facie meet the objection of lack of inventive step raised against claim 1 of the main request.

These late submitted requests should not be admitted.

(c) Auxiliary request III

No objections were raised against the set of claims of the auxiliary request III.

IX. The respondent argued essentially the following:

Document A12 was submitted with the grounds of appeal, thus at a very late stage, against the unchanged granted method-claim. It is not prima facie relevant because it refers to an apparatus and does not disclose a cooling method, and certainly not a method in which the coolant is circulated by means of a pump in an initial phase and additionally by the self-pumping effect of the coolant. Moreover, the appellant has failed to give any explanation or present any convincing reasons for the late filing of this document. Therefore document A12 should be disregarded (article 114(2) EPC). If not, the case should be remitted to the opposition division.

(a) Main request

The claimed cooling system differs from A4 not only as regards the redundant number of coolers and the valvings but also in that the cooling components are located within a refrigerator. The components of the

system are thus cooled themselves since a refrigerator has per definition a cooled inner space.

If the objective technical problem to be solved is to enhance the reliability of the system, the skilled person would not look at A1, which discloses "multiplicity" and not "redundancy" of coolers. When applying its general knowledge the skilled person would envisage several ways for rendering the system more reliable, as for instance selecting high quality products or duplicating all the components of the system, such as the compressors or the pipes. There is no hint to provide redundancy of the cryocoolers and valves for their selective connection to the system.

The disclosure of A12 concerns an apparatus and not a method. The system of A12 does not disclose a refrigerator within the meaning of the invention. Furthermore, the passage in column 6, lines 39 to 45, which refers to the provision of a circulating pump, is directed to a supply system and not to the cooling system. There is no implicit teaching either to provide a mechanical pump for circulating the coolant or for allowing a self-pumping in the coolant loop; from a general technical view, a pressurised source of gaseous coolant would be enough for proper circulation. No indication can be found in A12 of any self-pumping effect of the gaseous coolant. From the geometry and location of the cooling pipes in the region of the thermal load as shown in Figure 6 or A12, it is apparent that centripetal forces will act against centrifugal forces; this actually excludes any self-pumping. Nor would the skilled person automatically derive implicitly from A12 that self-pumping would

inevitably occur due to the thermal gradient in the coolant.

(b) Auxiliary requests I and II

The subject-matter of claim 1 of these requests has been limited to a specific type of thermal load to be cooled, namely superconducting windings or rotating superconducting windings, and thus provides a further distinction over the cooling system from A4. This renders the claimed system inventive.

(c) Auxiliary request III

No prior art discloses a method in which coolant is initially circulated by a pump and, after that starting phase, by a self-pumping effect.

- X. At the end of the oral proceedings which took place on 25 January 2011 the board announced its decision.

Reasons for the Decision

1. The appeal is admissible.
2. Main request
 - 2.1 Amendments

Claim 1 of the main request corresponds to claim 1 as maintained by the opposition division and is based on the combination of granted claims 1, 5 and 7.

Independent method-claim 9 corresponds to granted claim 13 with a corrected text in conformity with the wording of claim 13 of the grant at the end of the examining procedure ("Druckexemplar").

2.2 Inventive step

2.2.1 Closest state of the art

Document A4, which constitutes the closest prior art, discloses a cryogenic cooling system for cooling a remote thermal load 14. The adjective "remote" defines a distance between the refrigerator and the load, as mentioned in A4, column 1, lines 45 to 51, and shown by placing the load outside of the isolated cryogenic environment, namely outside of the vacuum space 14A enclosed within the wall 23. The system according to A4 comprises a cold-gas refrigerator 1 (see column 4, lines 39 to 64 and Figure 1a) which includes a cryogenically cooled surface (freezer 10) and a pump 15 for circulating the cryogenic gaseous helium between the cryogenically cooled surface 10 and the remote thermal load 14. The operative part of the pump 15 is disposed within the refrigerator 1 (see Figures 1 and 5). The heat transfer fluid is maintained as a single phase (gaseous helium) by the at least one cryogenically cooled surface.

The respondent cited passages of the patent, namely column 3, line 14 and lines 29 to 31, which defined in its opinion the refrigerator as being identical to a domestic refrigerator as normally understood, i.e. an apparatus in which the inner space is itself cooled. This would be hardly possible if the refrigerator was

just the heat exchanger cooling the cryogenic fluid, not including any further components such as the cryocoolers and their housing. On the other hand, figure 1 of the patent shows the refrigerator 12 as comprising the cryocoolers 13, fans, ducts, pumps, valving 18, etc., in a common housing. The term "refrigerator" as defined in the patent is, due to these inconsistencies, vague and cannot therefore distinguish from the arrangement shown in figure 1a of A4 where the heat exchanger proper 10,12 is disposed in a common housing 23 with further components such as the regenerator 9 of the cryocooler, ducts 11 and fan 22.

2.2.2 Objective problem

The claimed system differs from A4 in that it further comprises:

- a plurality of cryocoolers, each having a corresponding cryogenically cooled surface; and
- valving to selectively isolate at least one of the pluralities of the cryocoolers from the other plurality of cryocoolers.

The combined technical effect of these features and similarly the objective technical problem derivable therefrom is to improve the reliability of the cooling system in the event that one of the cryocoolers becomes non-operational or needs to undergo repair or routine maintenance. This definition of the problem to be solved is in line with the purpose of the claimed cooling system as disclosed in paragraph [0014] of the patent.

2.2.3 Obvious solution

The board does not agree with the grounds given in the impugned decision, which concludes that the solution was not obvious for the person skilled in the art. Though it can be conceived that the skilled person, when confronted with the issue of reliability of a heat-transfer arrangement, might first consider selecting high quality products and materials for each position of said arrangement, he would nonetheless mainly concentrate on what can be considered as the "heart" of the machine. It is general common knowledge to duplicate the crucial component ("heart") of a device so as to be able to isolate the broken component and replace it by the redundant one.

In the technology currently claimed, the "heart" piece of the cooling system obviously corresponds to the cryocooler(s) used for cooling the gaseous helium. The person skilled in the art would thus envisage the provision of redundant cryocoolers in the cooling system of A4 so as to obtain adequate system reliability. This applies in particular to the example cited at column 1, lines 32 to 33 of A4, namely the use of the cooling system for maintaining electronic circuits and infrared equipment at a low temperature, one obvious application being guiding systems for armed missiles or similar.

The use of redundant cryocoolers then obviously requires in turn the provision of connection switches, commonly valves and bypasses for selective operational connection of each cryocooler.

By applying his general knowledge the person skilled in the art would provide the cooling system known from A4

with redundant cryocoolers and adapted valves without the exercise of any inventive activity.

2.2.4 The cooling system defined in claim 1 of the main request therefore lacks an inventive step (Article 56 EPC) and is not allowable (Article 100(a), Article 52(1) EPC).

3. Auxiliary requests I and II

The amended claim 1 of both requests were filed during oral proceedings, thus at a late stage.

The respondent argued that the features newly added met the objection of lack of inventive step found for the main request.

The board however considers that the requirement of Article 56 EPC is not obviously met by the amended versions of claim 1; the reasons being as follow:

- claim 1 of both requests still defines a cooling system as such, the thermal load being merely one possible application of the system but not part of claimed invention; the indication of the field of application ("A cryogenic cooling system for cooling a remote **(rotating) superconducting windings** thermal load") can therefore not limit the cooling system as such; finally the fact that the system should be suitable for cooling supraconducting wires does not add a clear distinction as compared to claim 1 of the main request and to the system of A4;
- the addition "**while allowing continued operation of the system**" does not add anything to claim 1 since it was already implicitly comprised in the features

defining redundant cryocoolers and their connecting valves of claim 1 of the main request.

These auxiliary requests were thus not admitted.

4. Auxiliary request III

- 4.1 The set of claims of auxiliary request III has been limited to method-claims, claim 1 being the combination of claims 9 and 10 of the main request (in substance the combination of granted claims 13 and 14).

The method defines two phases of operation, namely an initial or starting phase, during which the mechanical pumping means are operated for circulating the single phase coolant through the cooling system towards the thermal load, and a second phase, after said initial phase, wherein the pumping means is stopped and the coolant circulated by only a self-pumping effect due to rotation of the thermal load and thermal gradient. The closest prior art is disclosed in A12 from which the skilled person would derive a circulation of a gaseous coolant in a closed loop by means of a pumping device. Due to the arrangement disclosed in A12, the skilled person would understand that, after an initial mechanical pumping phase, the gaseous coolant will incidentally be subject of a certain degree, even if small, of self-pumping due to centrifugal forces and thermal gradients applied to the coolant. However, there is no disclosure of, and not even an implicit basis whatsoever for, circulating the coolant only by means of the self-pumping effect after an initial phase.

The remaining cited prior art neither discloses the claimed method nor would it prompt the skilled person to arrive at a method using solely the self-pumping effect of the single phase coolant during the normal operating mode.

The appellant did not submit any arguments against patentability of the method according to auxiliary request III either.

The board arrives at the conclusion that the method of auxiliary request III meets the EPC.

- 4.2 The restriction of the claimed subject-matter to the method according to auxiliary request III requires a considerable and detailed revision of the whole description to bring it into conformity with the new definition of the invention. The board decided not to proceed with such a time consuming adaptation during the oral proceedings.

Order

For these reasons it is decided that:

1. The decision under appeal is set aside.

2. The case is remitted to the opposition division with the order to maintain the patent on the basis of claims 1 to 4 of the third auxiliary request filed during the oral proceedings after any necessary consequential adaptation of the description.

The Registrar:

The Chairman:

A. Counillon

U. Krause