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**Datasheet for the decision  
of 29 November 2016**

**Case Number:** T 0800/12 - 3.4.03

**Application Number:** 02796968.2

**Publication Number:** 1454330

**IPC:** H01G9/042, H01G9/052, C22C32/00

**Language of the proceedings:** EN

**Title of invention:**  
NIOBIUM ALLOY, SINTERED BODY THEREOF, AND CAPACITOR USING THE  
SAME

**Patent Proprietor:**  
Showa Denko K.K.

**Opponent:**  
H.C. Starck GmbH

**Headword:**

**Relevant legal provisions:**  
EPC Art. 123(2), 123(3)  
EPC 1973 Art. 54, 56, 83, 84, 100(a), 100(b), 100(c)

**Keyword:**

Grounds for opposition - fresh ground for opposition (no)  
Claims - clarity in opposition appeal proceedings  
Amendments - added subject-matter (no) - extension of the  
protection conferred (no)  
Novelty - (yes)  
Inventive step - (yes)

**Decisions cited:**

G 0010/91, G 0003/14, T 2017/07, T 1563/10

**Catchword:**



**Beschwerdekammern**  
**Boards of Appeal**  
**Chambres de recours**

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Case Number: T 0800/12 - 3.4.03

**D E C I S I O N**  
**of Technical Board of Appeal 3.4.03**  
**of 29 November 2016**

**Appellant:** H.C. Starck GmbH  
(Opponent) Im Schleeke 78-91  
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**Decision under appeal:** **Interlocutory decision of the Opposition**  
**Division of the European Patent Office posted on**  
**7 February 2012 concerning maintenance of the**  
**European Patent No. 1454330 in amended form.**

**Composition of the Board:**

**Chairman** G. Eliasson  
**Members:** T. M. Häusser  
C. Schmidt

## **Summary of Facts and Submissions**

- I. The appeal of the opponent concerns the interlocutory decision of the opposition division to maintain the European patent EP-B-1454330 as amended during the opposition proceedings (Article 101(3) (a) EPC).
- II. The opposition had been filed against the patent as a whole. Grounds of opposition were added subject-matter and lack of novelty and inventive step (Articles 54, 56, 100(a) and (c) EPC 1973).

In the course of the opposition proceedings the opponent raised a further ground of opposition under Article 100(b) EPC 1973. This new ground of opposition was not admitted into the proceedings by the opposition division.

- III. At the oral proceedings before the board the appellant (opponent) requested that the decision under appeal be set aside and that the patent be revoked.

The respondent (patent proprietor) requested as main request that the appeal be dismissed (i. e. the patent be maintained in the version maintained by the opposition division). As an auxiliary request the respondent requested that the decision under appeal be set aside and that the patent be maintained on the basis of auxiliary request submitted with letter dated 25 October 2016.

- IV. Reference is made to the following documents:

D1: DE 198 47 012 A,  
D8a: EP 1 093 137 A.

V. The wording of independent claims 1 and 5 as maintained by the opposition division, i. e. those corresponding to the main request, is as follows (board's labelling "(i)", "(ii)", "(iii)", and "(iv)"):

"1. A niobium alloy for capacitors comprising

- (i) as an alloy component from 0.1 to 10 atom % of only one element selected from the group consisting of: Zr, Y, La, Ce, Nd, Sm, Gd, Dy, Ho, Er, Yb, Ti, V, Ta, Mn, Ag, Zn, B, Al, Sb, Mg, and
- (ii) further comprising from 0.1 to 70 mass % of a diniobium mononitride crystal, and
- (iii) optionally comprising at least one element selected from the group consisting of boron, nitrogen, carbon and sulfur elements in addition to the alloy component and the diniobium mononitride,
- (iv) the balance of the alloy being niobium."

"5. A niobium composition powder for capacitors comprising from 0.1 to 10 atom % of only one element selected from the group consisting of: Zr, Y, La, Ce, Nd, Sm, Gd, Dy, Ho, Er, Yb, Ti, V, Ta, Mn, Ag, Zn, B, Al, Sb, Mg, which becomes an alloy component of a niobium alloy; from 0.1 to 70 mass % of a diniobium mononitride crystal; and as the balance niobium."

VI. The parties argued essentially as follows:

(a) Main request - sufficiency of the disclosure

The *appellant* (opponent) argued that the subject-matter of claims 2, 6, and 20 of the main request was not sufficiently disclosed as it was not shown for all claimed components how to work the invention. Moreover,

the subject-matter of claims 1 and 5 of the main request was not sufficiently disclosed because at least the elements Zr, Y, Sm, Zn, and Mg did not form an alloy with Nb as shown in the submitted phase diagrams and the generalization to the wide range of mass percentage of diniobium mononitrate was not permissible. Furthermore, the methods of preparation disclosed in the patent inevitably resulted in compositions comprising relevant amounts of elements not listed in claim 1 of the main request, for example Fe, Ni, and Co. However, these elements were excluded by the wording of that claim.

The *respondent* (patent proprietor) argued that this objection (lack of sufficient disclosure) had not been admitted into the proceedings before the opposition division and should therefore be disregarded as late-filed. Furthermore, the patent showed that the invention could be reduced to practice and the examples showed that the desired effect could be achieved; the appellant's objections, on the other hand, were mere speculation.

(b) Main request - clarity

The *appellant* argued that due to the presence in claim 1 of the main request of on the one hand "comprising" and on the other hand "the balance of the alloy being niobium" it was not clear whether a composition comprising further added components would fall within the scope of that claim. Moreover, the optional feature in claim 1 of the main request was neither clear nor concise and claims 2, 6, and 20 of the main request were not clear.

The *respondent* argued that the terms "comprising" and "the balance of the alloy being niobium" as well as the optional feature in claim 1 of the main request were already present in the patent as granted and that the objection was therefore not admissible. Moreover, in claims 2, 6, and 20 of the main request those elements listed in claims 1 and 5 of the main request were claimed that fell within groups 3 to 16 of the periodic table.

(c) Main request - amendments

The *appellant* argued the insertion of feature (iv) relating to the balance of the alloy being niobium into claim 1 of the main request and the corresponding amendment in claim 5 of the main request had no basis in the application as filed. This feature was neither explicitly described in nor directly and unambiguously derivable from the application as filed. Components other than the claimed ones were present in the alloys of the invention, for example oxygen and Fe, Cr, ... as described in the paragraph bridging pages 23 and 24 of the application. Moreover, in examples 45 and 47 of Table 3 of the application, boron oxide and tungsten trioxide, respectively, was added to the alloy so that some oxygen had to be present in the final product, which was however not indicated in the Table. Oxygen was also present in the alloys of the patent since the alloy components oxidized at the surface due to contact with water during the alloy preparation. Impurity elements were also expected to be present in the alloys due to contact with the preparation devices. From the description of the examples in the Tables it did not follow that no other components were present, in particular since the sum of the mass percentages did not add up to one hundred percent.

Furthermore, feature (i) relating to the alloy component constituted a non-admissible generalization of specific examples described in the patent having specific mass percentages and having been prepared by specific preparation methods.

Finally, the deletion of the elements W, Hf, Mo, Ba, and Si from the list of alloy components in claims 1 and 5 of the main request constituted an extension of the protection conferred, since these elements could now be present in a quantity of less than 0.1 atom % or more than 10 atom %. Moreover, claims 2, 6, and 20 of the main request extended the protection conferred.

The *respondent* agreed with the finding in the decision under appeal. The passage on pages 23-24 of the application related to the granulated product which was merely a preferred embodiment claimed in dependent claim 7 of the main request, which could well contain oxygen. Claim 1 of the main request, on the other hand, related only to the alloy. Moreover, impurities were always present and did not need to be explicitly mentioned; they were also present in smaller quantities than those of the claimed components.

Claim 1 of the main request was worded in closed form so that other components were excluded. Therefore, it was excluded that the deleted elements could be present in any amount.

(d) Main request - novelty

The *appellant* argued that the subject-matter of claim 1 of the main request was not new over documents D1 and D8a. It was disclosed in document D1 that due to the



production method the disclosed pulver contained large amounts of Mg. Moreover, it was disclosed that doping with N under high temperature conditions of up to 960°C was also performed. In addition, sintering was performed at a temperature well above 1000°C. Under such circumstance it was to be expected that diniobium mononitrate was inevitably formed; this could be deduced from the disclosure of document D8a, in particular test example 30. Other doping elements were not necessarily present.

Document D8a disclosed that the total amount of Fe, Ni, Co, Si, Na, K, and Mg in the powdered niobium was 350 ppm by weight or less (D8a, claim 2), wherein Mg was dominant as it was used as a reducing agent. Therefore it had to be assumed that Mg was present at around 300 ppm by weight. Moreover, niobium nitride was also present in the powdered niobium (D8a, claim 4), where diniobium mononitride was preferred (D8a, paragraph [0030]).

The *respondent* argued that apart from magnesium, phosphorus was also present in the embodiments of document D1, so that two alloy components were present. This was excluded by the wording of claim 1 of the main request. Moreover, the finding of the opposition division was correct that the alloys of D1 did not contain diniobium mononitride in the claimed amounts.

Moreover, several selections from various lists in document D8a were necessary in order to arrive at the claimed subject-matter. In any case, there was no disclosure that magnesium was the dominant part of the total amount of components disclosed in claim 2 of D8a. The remnants of magnesium had to be removed using washing steps which were indeed effective.

(e) Main request - inventive step

The *appellant* argued that document D8a was the closest state of the art. The advantage of improving the electrical properties mentioned in the patent was only shown to be achieved in comparison with pure niobium, but not in comparison with the alloy of the closest state of the art, which contained diniobium mononitride. The objective technical problem was therefore merely to provide an alternative alloy. The skilled person would consider document D1, which disclosed magnesium in the claimed amount. There was no statement in D1 that nitrogen and tantalum had to be present. It did not involve an inventive step to leave out these elements.

The *respondent* agreed with the appellant in that document D8a constituted the closest state of the art but argued that the presence of the alloy component in the claimed amounts allowed greater variability of the components of the alloy. In view of Table 2 of document D8a the skilled person had to conclude that high impurity contents had to be avoided. There was no reason for the skilled person to consider document D1.

## **Reasons for the Decision**

1. Main request - sufficiency of the disclosure
  - 1.1 In the opposition proceedings the opposition division did not admit the objection of lack of sufficient disclosure into the proceedings as the objection was deemed late filed and not *prima facie* relevant (see point 3.3 of the Reasons of the contested decision).

1.2 The *appellant* (opponent) argued that the subject-matter of claims 2, 6, and 20 of the main request was not sufficiently disclosed as it was not shown for all claimed components how to work the invention. Moreover, the subject-matter of claims 1 and 5 of the main request was not sufficiently disclosed because at least the elements Zr, Y, Sm, Zn, and Mg did not form an alloy with Nb as shown in the submitted phase diagrams and the generalization to the wide range of mass percentage of diniobium mononitrate was not permissible. Furthermore, the methods of preparation disclosed in the patent inevitably resulted in compositions comprising relevant amounts of elements not listed in claim 1 of the main request, for example Fe, Ni, and Co. However, these elements were excluded by the wording of that claim.

1.3 According to established jurisprudence of the boards of appeal, if the way in which a department of first instance has exercised its discretion on a procedural matter is challenged in an appeal, it is not the function of a board of appeal to review all the facts and circumstances of the case as if it were in the place of the department of first instance, and to decide whether or not it would have exercised such discretion in the same way as the department of first instance. A board of appeal should only overrule the way in which a department of first instance has exercised its discretion if the board concludes it has done so according to the wrong principles, or without taking into account the right principles, or in an unreasonable way (see "Case Law of the Boards of Appeal of the EPO", 8th edition 2016, section IV.E.3.6).

1.4 In the present case, the appellant did not argue that the opposition division exercised its discretion concerning the admission of the objection of lack of sufficient disclosure according to the wrong principles, or without taking into account the right principles, or in an unreasonable way.

Indeed, according to the decision G 10/91 of the Enlarged Board of Appeal (OJ EPO 1993, 420), the applicable principle is that the consideration of fresh grounds should only take place in cases where, *prima facie*, there are clear reasons to believe that such grounds are relevant and would in whole or in part prejudice the maintenance of the patent (see point 16 of the Reasons). Hence, the opposition division exercised its discretion according to the right principles. Moreover, the board sees no indication that the opposition division exercised its discretion in an unreasonable way. Accordingly, the board concludes that the opposition division's decision not to admit the objection of lack of sufficient disclosure into the proceedings should not be overruled.

1.5 Moreover, the Enlarged Board held in the above decision G 10/91 that a fresh ground may in principle not be introduced at the appeal stage and that an exception to this principle is justified in case the patentee agrees that the fresh ground for opposition may be considered (see point 18 of the Reasons).

In the present case the respondent did not agree that the objection of lack of sufficient disclosure may be considered during the appeal proceedings. Therefore, the board has no power to introduce the objection for the first time at the appeal stage.

- 1.6 In view of the above, the objection of lack of sufficient disclosure is not admitted into the appeal proceedings.
2. Main request - clarity
  - 2.1 The appellant argued that, due to the presence in claim 1 of the main request of "comprising" on the one hand and "the balance of the alloy being niobium" on the other hand, it was not clear whether a composition comprising further added components would fall within the scope of that claim. Moreover, the optional feature in claim 1 of the main request was neither clear nor concise and claims 2, 6, and 20 of the main request were not clear.
  - 2.2 The board notes that in its decision G 3/14 (OJ EPO, A102) the Enlarged Board of Appeal held that, in considering whether, for the purposes of Article 101(3) EPC, a patent as amended meets the requirements of the EPC, the claims of the patent may be examined for compliance with the requirements of Article 84 EPC only when, and then only to the extent that the amendment introduces non-compliance with Article 84 EPC.
  - 2.3 The terms "comprising" and "the balance of the alloy being niobium" were already present in claim 1 as granted so that the alleged lack of clarity resulting from the interaction between these terms cannot be considered as being introduced by the amendments to the patent effected during the opposition proceedings, which concern the selection of possible alloy components. The same holds for the optional feature (iii) of claim 1.

Claims 2, 6, and 20 correspond essentially to claims 2, 6, and 20 as granted with a slight adaptation to conform to the amended selection of possible alloy components defined in independent claims 1 and 5, respectively. Hence, the alleged lack of clarity of the additional features defined in these dependent claims cannot be considered as being introduced by the amendments to the patent effected during the opposition proceedings, either.

Therefore, the appellant's objections in relation to Article 84 EPC 1973 may not be examined in the present opposition appeal proceedings.

3. Main request - amendments

3.1 Added subject-matter

3.1.1 The opposition division held in the contested decision that the former auxiliary request, which corresponds to the present main request, fulfilled the requirements of Article 123(2) EPC (see point 4.2.2 of the Reasons).

3.1.2 The appellant argued that the insertion of feature (iv) relating to the balance of the alloy being niobium into claim 1 of the main request and the corresponding amendment in claim 5 of the main request had no basis in the application as filed. This feature was neither explicitly described in nor directly and unambiguously derivable from the application as filed. Components other than the claimed ones were present in the alloys of the invention, for example oxygen and Fe, Cr, ... as described in the paragraph bridging pages 23 and 24 of the application. Moreover, in examples 45 and 47 of Table 3 of the application, boron oxide and tungsten trioxide, respectively, was added to the alloy so that

some oxygen had to be present in the final product, which was however not indicated in the Table. Oxygen was also present in the alloys of the patent since the alloy components oxidized at the surface due to contact with water during the alloy preparation. Impurity elements were also expected to be present in the alloys due to contact with the preparation devices. From the description of the examples in the Tables it did not follow that no other components were present, in particular since the sum of the mass percentages did not add up to one hundred percent.

Furthermore, feature (i) relating to the alloy component constituted a non-admissible generalization of specific examples described in the patent having specific mass percentages and having been prepared by specific preparation methods.

- 3.1.3 First of all, the board notes that claim 1 of the main request stipulates that the niobium alloy comprises the claimed amounts of one the listed alloy components and a diniobium mononitride crystal and optionally at least one of the listed elements, the balance being niobium.

In accordance with standard interpretation of such claims this wording defines a closed composition in which - except for unavoidable impurities - the presence of further elements is excluded (see T 1563/10, point 2.1 of the Reasons). A similar wording is used in claim 5 of the main request which is thus also directed to a closed composition.

- 3.1.4 As mentioned above, even though claims 1 and 5 define closed compositions, the presence of unavoidable impurities is not excluded by the wording of these claims. The impurities may be present, for example, due

to contact with the preparation apparatus (see paragraph [0039] of the patent, which corresponds to the paragraph bridging pages 23 and 24 of the application) and the skilled person would understand that the amount of these impurities is so low that they do not interfere with the purpose and object of the invention.

- 3.1.5 Concerning the alleged presence of oxygen in the niobium alloy of the invention the board agrees with the respondent in that the indication of the oxygen amount in paragraph [0039] of the patent does not relate to the niobium alloy itself, but to the *granulated product* (see paragraphs [0038]-[0039] of the patent), which may be obtained from the niobium alloy of the invention as indicated, for example, in claims 7 to 9 of the main request, which depend on claim 5 of the main request.

Moreover, there is no indication that oxygen is inevitably present in the alloys beyond impurity level due to the disclosed preparation methods. Specific examples on the other hand, such as examples 45 and 47, in which oxides of the alloy component elements are used in the preparation method, may well be considered as not representing embodiments of the invention due to their oxygen content.

- 3.1.6 Finally, the column "ratio by mass" in Table 2 of the patent provides only the *relative masses* of the indicated components. The presence of other components is therefore not implied by the mere fact that the relative masses do not add up to one hundred.
- 3.1.7 Consequently, the board sees no reason to differ from the opposition division's finding that the subject-matter of feature (iv) of claim 1 of the main request



is directly and unambiguously derivable from the disclosure of the invention in the description of the application, in particular the examples.

Corresponding considerations hold for claim 5 of the main request.

- 3.1.8 The board notes further that a niobium alloy comprising as an alloy component from 0.1 to 10 atom % of only one element selected from the group consisting of the elements belonging to Groups 2 to 16 of the periodic table and also comprising the subject-matter of features (ii) and (iii) of claim 1 of the main request is directly and unambiguously derivable from original claims 1, 3, 4, and 7 and the description as originally filed (page 15, lines 19-22).

Moreover, having regard to the examples described on pages 56 and 57 of the description and listed in Tables 2 and 3 of the application, it is evident for the skilled person that the particular elements listed in feature (i) of claim 1 of the main request are the preferred elements of Groups 2 to 16 of the periodic table for use in the alloy according to the invention. In addition, there is no clearly recognizable functional or structural relationship among the features of the specific examples, namely the particular selected elements and the indicated mass ratios and preparation methods.

The subject-matter of features (i) to (iii) of claim 1 of the main request is therefore also considered to be directly and unambiguously derivable from the original application documents. The same holds for claim 5 of the main request.

3.1.9 Accordingly, the board is satisfied that the amendments in relation to claims 1 and 5 of the main request comply with the requirements of Article 123(2) EPC.

3.2 Extension of the protection conferred

3.2.1 The appellant referred to the decision T 2017/07 of the Boards of Appeal and argued that the deletion of the elements W, Hf, Mo, Ba, and Si from the list of alloy components in claims 1 and 5 of the main request constituted an extension of the protection conferred, since these elements could now be present in a quantity of less than 0.1 atom % or more than 10 atom %. Moreover, claims 2, 6, and 20 of the main request extended the protection conferred.

3.2.2 Claim 1 of the main request was amended during the opposition proceedings in that the elements W, Hf, Mo, Ba, and Si were deleted from the list of possible alloy components. However, in contrast to the claim considered in the decision T 2017/07, which was directed to an *openly defined* composition, claim 1 of the main request is worded to define a *closed composition* (see point 3.1.3 above). Therefore, according to the amended claim wording the presence of the deleted elements is excluded so that these elements may neither be present in a quantity of less than 0.1 atom % nor in a quantity of more than 10 atom %. The same holds for claim 5 of the main request.

3.2.3 Claims 2 and 6 of the main request are dependent on claims 1 and 5 of the main request, respectively. Claim 20 of the main request is dependent on claim 14 of the main request, which relates to a method for producing a capacitor and contains a reference to the alloy according to claim 1 or 2 of the main request. Claims

2, 6, and 20 of the main request define a subset of the elements listed in claims 1 and 5 of the main request, namely those from Groups 3 to 16 of the periodic table and therefore have narrower scope than the claims they refer to and do not extend the protection conferred.

3.2.4 In view of the above, the board is satisfied that the amendments of the patent do not extend the protection it confers, as required by Article 123(3) EPC.

4. Main request - novelty

4.1 Document D1

4.1.1 The opposition division held in the contested decision that the subject-matter of claim 1 of the main request (former auxiliary request) was new over document D1. In particular, D1 did not disclose feature (ii) of that claim concerning the presence of a diniobium mononitride crystal (see point 4.2.3 of the Reasons).

4.1.2 The appellant argued that it was disclosed in document D1 that due to the production method the disclosed pulver contained large amounts of Mg. Moreover, it was disclosed that doping with N under high temperature conditions of up to 960°C was also performed. In addition, sintering was performed at a temperature well above 1000°C. Under such circumstance it was to be expected that diniobium mononitrate was inevitably formed; this could be deduced from the disclosure of document D8a, in particular test example 30. Other doping elements were not necessarily present.

4.1.3 Document D1 discloses (see page 2, line 14 - page 5, line 60) a niobium pulver for capacitors, which is produced by means of reduction of niobium oxide using

alkaline earth and/or rare earth metals. In particular,  $\text{NbO}_x$  is obtained in a first reducing step followed by a washing step and then treated in a second reducing step. Preferably, the  $\text{NbO}_x$  pulver is mixed with magnesium chips, heated for several hours, cooled and then washed with acid.

The niobium pulver may be doped with at least one of the elements nitrogen, phosphorus, boron or sulfur. The niobium pulver is soaked with a solution containing the doping material, dried to remove the solvent and heated to a temperature between 750 to 960°C for one to four hours so that the dopant diffuses in a reducing manner into the niobium. For this to happen, magnesium chips are added and also heated to the diffusion temperature. Excess magnesium and magnesium oxide are washed away using mineral acid. The resulting niobium powder may eventually be sintered at 1150°C for 20 minutes. Tables 1 and 2 show the reduction conditions and doping amounts for six different examples. In particular, in relation to example 2 it is disclosed that the  $\text{NbO}_x$  pulver is mixed with ammonium chloride ( $\text{NH}_4\text{Cl}$ ) and reduced to metal under the indicated conditions.

- 4.1.4 The opposition division pointed out in the decision under appeal (see page 7, last paragraph) that the doping of the niobium powder with nitrogen in document D1 was performed in an entirely different manner from the nitrogen treatment of the niobium powder in document D8a. Indeed, in contrast to the above nitrogen doping using ammonium chloride disclosed in D1, document D8a discloses in relation to test example 30 (see paragraphs [0071] and [0073]) that the niobium powder is left standing in a nitrogen atmosphere at 800°C for three hours to obtain partially nitrided powdered niobium. A mixture of this powder and 5 wt% of dinio-  
bium

mononitride crystal is compacted and left standing in vacuum for 30 minutes while raising the temperature at a rate of 10°C/min to a maximum temperature of 1100°C. Subsequently, the temperature is dropped at an average dropping rate of about 80°C/min while charging Ar gas to obtain a sintered body. In the sintered body, the amount of diniobium mononitride crystal is 6.3 wt%.

Such mixing with a diniobium mononitride crystal, which is expected to generate further growth of the crystal, is not disclosed in document D1, either.

Consequently, it cannot be inferred from document D8a that the preparation conditions of document D1 will inevitably result in diniobium mononitride crystals. Moreover, the board does not see any other reason to believe that the compounds of document D1 contain diniobium mononitride crystals.

Hence, the subject-matter of feature (ii) is not disclosed in document D1.

4.1.5 Furthermore, example 1 of document D1 is not reported to contain any of the alloy components listed in feature (i). On the other hand, examples 2 to 6 are reported to contain not only magnesium, but also phosphorus, oxygen and tantalum (see Tables 1 and 2 of D1). However, both magnesium and tantalum are listed in feature (i).

Therefore, none of the examples of D1 discloses that the niobium compound comprises only one of the elements listed in feature (i). This cannot be inferred from the general description of the invention in document D1, either. Consequently, document D1 does not disclose the

subject-matter of feature (i) of claim 1 of the main request.

- 4.1.6 Finally, the presence of phosphorus and oxygen in all examples of D1 implies that they do not fall under the wording of claim 1 of the main request as a whole, the claim being directed to a closed composition not comprising either of these elements (see point 3.1.3 above).
- 4.1.7 In view of the above the board concludes that the subject-matter of claim 1 of the main request is new over document D1 (Article 52(1) EPC and Article 54(1) EPC 1973).
- 4.2 Document D8a
  - 4.2.1 The opposition division held further that the subject-matter of claim 1 of the main request was new over document D8a. In particular, D8a did not disclose feature (i) of that claim concerning the alloy component (see point 4.2.4 of the Reasons of the decision).
  - 4.2.2 The appellant argued that document D8a disclosed that the total amount of Fe, Ni, Co, Si, Na, K, and Mg in the powdered niobium was 350 ppm by weight or less (D8a, claim 2), wherein Mg was dominant as it was used as a reducing agent. Therefore it had to be assumed that Mg was present at around 300 ppm by weight. Moreover, niobium nitride was also present in the powdered niobium (D8a, claim 4), where diniobium mononitride was preferred (D8a, paragraph [0030]).
  - 4.2.3 Document D8a discloses (see paragraphs [0010], [0030], and [0061]-[0079]) powdered niobium for a capacitor.

In particular, as a first objective it is reported in D8a that a capacitor having a small dispersion in the specific leakage current value can be obtained provided that a powdered niobium for a capacitor contains impurity elements such as iron, nickel, cobalt, silicon, sodium, potassium and magnesium each in an amount of about 100 ppm by weight or less, and these elements in a total amount of 350 ppm by weight or less. Twenty-four powdered niobium test examples are produced whose composition is shown in Table 2.

Furthermore, as a second objective it is reported that, for improving the high temperature property, the sintered body of niobium may contain niobium monoxide crystal (NbO) and/or diniobium mononitride crystal (Nb<sub>2</sub>N) (see paragraph [0030]). Sintered bodies made of powdered niobium, niobium monoxide crystal and/or diniobium mononitride crystal are produced as test examples 25 to 35, whose properties are shown in Table 4. Test example 30 is reported to contain nitrogen, 6.3 wt % of diniobium mononitride crystal and less than 0.1 wt % of niobium monoxide crystal (see paragraph [0073] and Table 4).

Using the wording of claim 1 of the main request document D8a discloses in relation to test example 30 a niobium alloy for capacitors comprising

- from 0.1 to 70 mass % (namely 6.3 wt %) of a diniobium mononitride crystal, and
- optionally comprising at least one element selected from the group consisting of boron, nitrogen, carbon and sulfur elements (namely nitrogen),
- the balance of the alloy being niobium (powdered niobium).

4.2.4 The board notes that magnesium is not mentioned in document D8a as the only reducing agent. For example, in paragraph [0015] it is mentioned that sodium may be used for reducing potassium niobium halide or niobium fluoride. Sodium was also used as a reducing agent in test examples 10 to 19 (see paragraphs [0064]-[0067]). Even when magnesium is used, as in test examples 1 to 9, washing steps are used to remove it (see paragraph [0061]). Accordingly, even among the test examples using magnesium as a reducing agent and falling under the terms of the invention of D8a as defined in claims 1 or 2 of D8a, i. e. test examples 3 to 9, the highest magnesium content is only 60 wt ppm (see Table 2 of D8a). When the ratio of the atomic weights of niobium and magnesium (which is about 4) is taken into account, this corresponds to only about 0.02 atom %, which is far below the lower limit specified in feature (i) of claim 1 of the main request.

Moreover, even though in claim 4 of D8a it is specified that the powdered capacitor of claims 1 or 2 contains at least one of niobium nitride, niobium carbide and niobium boride, there is no disclosure that the niobium nitride is in the form of a dinobium mononitride crystal, let alone that this crystal is present in the amount specified in feature (ii) of claim 1 of the main request. There is also no disclosure that the features of the second group of test examples 25 to 35 relating to the second objective of D8a can be combined with those of the first group of test examples 1 to 24 relating to the first objective.

Hence, the subject-matter of feature (i) of claim 1 of the main request is not disclosed in document D8a.



4.2.5 Consequently, the board concludes that the subject-matter of claim 1 of the main request is new over document D8a (Article 52(1) EPC and Article 54(1) EPC 1973).

5. Main request - inventive step

5.1 Closest state of the art, distinguishing features

As in the contested decision, both parties consider document D8a as the closest state of the art. Indeed, document D8a discloses subject-matter that is conceived for the same purpose as the claimed invention, namely for providing a niobium alloy for capacitors, and has the most relevant technical features in common with it, as detailed under point 4.2.3 above. Document D8a is therefore regarded as the closest state of the art.

The subject-matter of claim 1 of the main request differs from the niobium alloy of document D8a in comprising feature (i) (see points 4.2.3 and 4.2.4 above).

5.2 Objective technical problem

5.2.1 In the contested decision the opposition division stated that it did not share the opponent's opinion that the effects of the invention, i. e. to provide superior properties such as high capacitance and low current leakage values and high temperature resistance, were not obtained by the claimed compound (see point 4.2.4 of the Reasons).

5.2.2 The appellant argued that the advantage of improving the electrical properties mentioned in the patent was only shown to be achieved in comparison with pure

niobium, but not in comparison with the alloy of the closest state of the art, which contained diniobium mononitride. The objective technical problem was therefore merely to provide an alternative alloy.

- 5.2.3 The board notes that it is specified in the patent (see paragraph [0019]) that the specific alloy components of the invention improve the deterioration of the oxide dielectric film due to heat distortion at high temperatures. Furthermore, by incorporating a diniobium mononitride crystal into the niobium alloy, the heat distortion is more relieved so that the capacitor using this niobium has improved high-temperature property and heat resistance property. It is thus the combined presence of the claimed alloy components and the diniobium mononitride crystal which allows the capacitor to have the improved high-temperature and heat resistance properties.

The appellant merely asserted that the advantages of the invention were not achieved but did not provide any evidence, for example in the form of comparative tests, or a logical chain or arguments showing that the advantages were not attained for at least some of the claimed alloy components. The board is therefore not convinced by the appellant's assertions and sees no need to reformulate the technical problem.

The objective technical problem is therefore to allow the capacitor to have improved high-temperature and heat resistance properties.

### 5.3 Obviousness

- 5.3.1 The opposition division held that the skilled person would not arrive at the claimed alloy, in particular

when considering document D1 (see point 4.2.4 of the Reasons).

- 5.3.2 The appellant argued that the skilled person would consider document D1, which disclosed magnesium in the claimed amount. There was no statement in D1 that nitrogen and tantalum had to be present. It did not involve an inventive step to leave out these elements.
- 5.3.3 In document D1 it is not disclosed to use the claimed alloy components to allow the resulting capacitors to have improved high-temperature and heat resistance properties. In particular, the high content of magnesium or tantalum in the alloy disclosed in D1 is merely due to the use of magnesium as a reducing agent and tantalum lined reactors but is not reported to have advantageous effects on the properties of the capacitor (see D1, page 4, lines 14-19). The skilled person would therefore not consider to use the magnesium or tantalum content disclosed in D1 in order to solve the posed problem.

Moreover, document D8a discloses that a pulverized hydrogenated niobium ingot is used for preparing the alloy containing a diniobium mononitride crystal and representing the closest state of the art (see paragraph [0073] of document D8a). There is thus no reason to use the reducing agent or reactor of document D1 in the method of producing the alloy representing the closest state of the art.

Finally, even if the skilled person were to consider combining the teachings of documents D1 and D8a, the skilled person would not be led to the claimed subject-matter due to the fact that document D1 does not disclose feature (i) and due to the presence of

phosphorus and oxygen in all examples of document D1 (see points 4.1.5 and 4.1.6 above).

Consequently, the subject-matter of claim 1 of the main request involves an inventive step (Article 52(1) EPC and Article 56 EPC 1973).

6. Conclusion

Since all objections against the main request (i. e. the patent in the version maintained by the opposition division) fail, the appeal must be dismissed.

**Order**

**For these reasons it is decided that:**

The appeal is dismissed.

The Registrar:

The Chairman:



S. Sánchez Chiquero

G. Eliasson

Decision electronically authenticated