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Datasheet for the decision of 28 July 2009

Case Number: T 0682/07 - 3.2.03

Application Number: 97946465.8

Publication Number: 0946323

IPC: B22F 1/00, H01G 9/042, H01G 9/052

Language of the proceedings: EN

Title of invention:
Niobium powders and niobium electrolytic capacitors

Patentee:
CABOT CORPORATION

Opponent:
Roy Marsh

Headword:
-

Relevant legal provisions:
EPC Art. 56

Relevant legal provisions (EPC 1973):
-

Keyword:
"Inventive step (yes)

Decisions cited:
T 0020/94

Catchword:
-

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Beschwerdekammern | Boards of Appeal | Chambres de recours

Case Number: T 0682/07 - 3.2.03

D E C I S I O N
of the Technical Board of Appeal 3.2.03
of 28 July 2009

Appellant: (Patent Proprietor)	CABOT CORPORATION Two Seaport Lane Suite 1300 Boston Massachusetts 02210-2019 (US)
Representative:	Grünecker, Kinkeldey Stockmair & Schwanhäusser Anwaltssozietät Leopoldstrasse 4 D-80802 München (DE)
Respondent: (Opponent)	Roy Marsh Hoffmann Eitle Arabellastrasse 4 D-81925 München (DE)
Representative: q	HOFFMANN EITLE Patent- und Rechtsanwälte Arabellastrasse 4 D-81925 München (DE)
Decision under appeal:	**Decision of the Opposition Division of the European Patent Office posted 14 February 2007 revoking European patent No. 0946323 pursuant to Article 102(1) EPC.**

Composition of the Board:

Chairman: U. Krause
Members: G. Ashley
K. Garnett

Summary of Facts and Submissions

I. Grant of the patent was opposed on the grounds that its subject-matter was not novel and did not involve an inventive step (Article 100(a) EPC) and that the disclosure was not sufficiently clear and complete (Article 100(b) EPC). The Opposition Division concluded that the subject-matter of claims 1 of the main, first and second auxiliary requests lacked novelty, and that of claim 1 of the third auxiliary request lacked an inventive step. The decision was therefore taken to revoke the patent. The ground of insufficient disclosure was not considered by the Opposition Division.

II. The above decision was posted by the Opposition Division on 14 February 2007. The Appellant (Patent Proprietor) filed notice of appeal on 17 April 2007, paying the appeal fee on the same day. A statement setting out the grounds of appeal was filed on 25 June 2007, together with a main request and six auxiliary requests.

In accordance with Article 15(1) of the Rules of Procedure of the Boards of Appeal, the Board issued a preliminary opinion together with a summons to attend oral proceedings, setting out its view on inventive step. In response to the preliminary opinion, the Appellant filed with the letter of 7 May 2009 seven auxiliary requests as new auxiliary requests 2 to 8, and the Respondent filed documents X1 to X4 with the letter also dated 7 May 2009. The oral proceedings were duly held on 28 July 2009.

III. Requests

The Appellant requests that the decision under appeal be set aside and the patent be maintained on the basis of the second auxiliary request filed with the letter dated 7 May 2009.

The Respondent requests that the appeal be dismissed.

IV. Claims

Claim 1 of the second auxiliary request filed with the letter dated 7 May 2009 reads as follows:

"1. A capacitor anode obtainable from a niobium powder having a BET surface area of at least 1.0 m^2/g, wherein the capacitor anode has a DC leakage of less than 5.0 nA/CV and a capacitance of from 30,000 CV/g to 61,000 CV/g."

Claims 2 to 6, 25 and 26 concern preferred embodiments of the capacitor anode of claim 1. Independent claim 7 is directed to a method of forming the capacitor anode of claims 1 to 6, with dependent claims 8 to 24 defining preferred embodiments of the method. Independent claim 27 and dependent claims 28 and 29 concern use of niobium powder to produce a capacitor anode having the properties defined in claim 1.

V. Prior Art

(a) The following documents referred to in the decision were cited during the opposition proceedings.

D1: US-A-4 347 084

D4: US-A-3 849 124

D5: M. Krehl et al. "The Influence of Gas Atmospheres on the First-Stage Sintering of High-Purity Niobium Powders", Met. Trans. A, Vol. 15A, pages 1111 to 1116, June 1984.

D7: US-A-3 169 862

D11: Yu. V. Levinskii et al., "Relationship between the Specific Charge of Niobium Anodes and Parameters of their Porous Structure", Translation of Poroshkovaya Metallurgiya, No.5(341), pages 61 to 64 (translated pages 403 to 406), May 1991.

(b) The following documents were submitted with the Respondent's letter of 7 May 2009:

X1: J. Gill, "Basic Tantalum Capacitor Technology" Technical Information from AVX Ltd, Tantalum Division, Paignton, Great Britain.

X2: Six pages printed from the internet website www.absoluteastronomy.com, entitled "Anodising".

X3: N. Schwartz et al., "Niobium Solid Electrolytic Capacitors", Journal of the Electrochemical Society, Vol. 108, No. 8, pages 750 to 758, 1961.

X4: M.A. Biason Gomes et al., "Anodization of Niobium in Sulphuric Acid Media", Journal of Applied Electrochemistry, 21, pages 1023 to 1026, 1991.

VI. Summary of the Submissions of the Parties

(a) Appellant

The Appellant emphasised that claim 1 concerns a capacitor anode having low DC leakage, as defined according to the accepted industrial standard, combined with high capacitance. The cited documents disclose capacitor anodes having lower capacitances than that of claim 1. Although document D5 discloses a capacitance of 25,000 CV/g (see Table 1), this is still below the claimed value (30,000 to 61,000 CV/g); in addition, this is a theoretical value based on corresponding tantalum particles. D5 does not provide any information about the corresponding DC leakage values.

Regarding D11, this document relates to the determination of the relationship between the parameters of the porous structure of a shaped anode and its specific charge; it is not concerned with the properties of a capacitor, and in particular does not mention the problem of DC leakage.

Regarding X3, the capacitance is defined in claim 1 as CV/g, and this corresponds to the constant slope of the graphs shown in Figures 1 and 3, so that if CV/g is plotted against formation voltage for the values given in X3, the value for capacitance remains constant. Consequently, Figures 1 and 3 do not show an increase in CV/g as the formation voltage is reduced. The sintering results in Table III show the generally known effect that as sintering temperature increases DC leakage is reduced, whilst capacitance is also reduced.

Prior art documents D7, D11 and X3 may consider the individual effects of some process parameter such as specific surface area, sintering temperature, formation voltage and oxygen content on either the capacitance or the leakage, but the patent teaches that an advantageous combination of high capacitance and low leakage can be obtained by selecting particular values of each of these parameters, namely high specific surface area and oxygen content, combined with a low sintering temperature and formation voltage, as specified in examples 5 to 8.

Since there is no indication in the prior art that the claimed capacitance can be achieved whilst maintaining low DC leakage, the claimed subject-matter has an inventive step.

(b) Respondent

Concerning the late-filed documents, the Respondent argued that these were submitted in response to the views expressed by the Board in the annex to the summons to oral proceedings. X1 is a publication from a company, AVX Ltd, and although the publication date of X1 is not explicitly shown on the document, the Respondent stated that he had received an e-mail from the technical and quality director of AVX Ltd., stating that the month and year (July 1995) is embedded in the ID code given to the paper. Document X2 is from an internet encyclopaedia, and although not furnished as prior art, shows the knowledge of the skilled person. Document X3 is a highly relevant publication from the Journal of the Electrochemical Society. Document X4

shows the colours of niobium oxide layers resulting from various formation voltages.

Regarding the definition of features in claim 1, the Respondent submitted that the definition of BET surface of the niobium starting powder is not a feature of the capacitor anode, since it is not discernible in the final product. In addition, the DC leakage of a capacitor is time dependent, depending on whether it is measured immediately after manufacture or after some time in service. Without knowledge of the conditions of measurement, the feature defined in claim 1 has no clear meaning.

The Respondent alleged that claim 1 merely refers to the problem and not the solution. Furthermore, the patent specification itself does not disclose the solution, as there is no example of an anode having both the claimed properties of DC leakage and capacitance. In particular, examples 5 to 7 show the capacitance to lie within the claimed range, but values for DC leakage are omitted. According to the Respondent the specification fails to disclose the technical effect underlying the invention, and the claimed combination of properties cannot be achieved on the basis of the experiments presented in the patent specification. Since the alleged inventive effect has not been shown to exist, the claimed subject-matter lacks an inventive step.

In addition, there is a lack of inventive step in light of the cited prior art and the general knowledge of the skilled person.

Documents D1 and D4 disclose capacitor anodes made from niobium powder having a DC leakage falling within the claimed range, but with lower capacitance. High capacitance and low DC leakage are contradictory properties, as mentioned in D7. However, effects such as surface area of powders, oxygen content of the starting material, the formation voltage, sintering conditions etc, all have a bearing on the surface area and insulation and hence on capacitance and leakage, and these are all well known in the art. It is the normal task of the skilled person to select such process parameters in order to obtain the desired compromise between capacitance and DC leakage.

Powders having higher degrees of purity and finer particle sizes have become available in recent years, and the claimed properties are merely a consequence of applying the known process parameters with known effects to such powders. In particular, D11, published shortly before the priority date of the disputed patent, employs lower sintering temperatures to produce high capacitance, as taught in the disputed patent. X3 (Figures 1 and 3) teaches that low formation voltages are also conducive for attaining high capacitance, as is also taught in the disputed patent. All the measures adopted in the patent represent standard tools that are employed in known ways for making capacitor anodes having the desired properties. The claimed feature combination is nothing more than the predictable outcome of progressive optimisation of niobium powders, over long years, up to the priority date of the contested patent.

Starting from the disclosures of either D1 or D4, the skilled person would obtain a capacitor anode having the claimed properties merely by applying standard processing steps to known materials. Hence, the claimed subject-matter lacks an inventive step.

Reasons for the Decision

1. The appeal is admissible.

2. Late-Filed Documents

2.1 In response to the provisional opinion issue by the Board together with the invitation to oral proceedings, the Respondent filed four new documents, of which X3 was considered to be prima facie highly relevant. The Board therefore decided to exercise its discretion under Article 13 of the Rules of Procedure of the Boards of Appeal and admit this document into the proceedings.

2.2 The e-mail from the Technical and Quality Director of AVX Ltd. was not presented to the Board, and in any event would be insufficient to establish the publication date of X1. Document X2 is a printout from the internet and the circumstances of its publication are unknown. Since the publication of documents X1 and X2 have not been firmly established, and they would not prima facie have a significant bearing on the outcome of the decision, they were not admitted into the proceedings. X4 is of no more relevance than documents that are already in the proceedings, and hence was also not admitted into the proceedings.

3. Claim 1 - Formal Requirements

Present claim 1 corresponds to dependent claim 5 of the granted patent with the BET surface area amended to be at least 1.0 m^2/g, compared with 0.5 m^2/g, as defined in granted claim 1. The amendment finds support in the application as originally filed (WO-A-98/19811) at page 5, line 18; claim 1 thus complies with the requirements of Articles 123(2) and (3) EPC. The definition of the BET surface area is clear, hence there is also no objection under Article 84 EPC to the amendment.

4. Novelty (Article 54 EPC)

None of the cited prior art documents discloses a capacitor anode having the combination of DC leakage and capacitance defined in claim 1, hence the subject-matter of this claim is novel.

5. Inventive Step (Article 56 EPC)

5.1 Starting Point

Claim 1 is directed to a capacitor anode obtainable from a niobium powder having a given BET surface area, and for which the DC leakage and capacitance is defined.

It is established case law of the Boards of Appeal that terms such as "obtained" or "obtainable" have equivalent meaning (see for example T 20/94 at 4.4). The claim therefore does not just concern any capacitor anode having the claimed properties, but specifically

relates to one made from niobium powder. However, the Board fully agrees with the view of the Opposition Division that it is not possible to determine whether or not a capacitor anode has been made from a powder having a given BET surface area, because the final surface area of the anode is heavily influenced by the sintering conditions; hence this feature is of little significance in defining the capacitor anode.

Both documents D1 and D4 disclose capacitor anodes made from niobium powders (see Example 11 of D1 and Table 8-1 of D4), and hence form an appropriate starting point for the assessment of inventive step.

The Opposition Division calculated the DC leakages of the capacitor anodes of D1 (Example 11) and D4 (Table 8-1) to be 1.7 nA/CV and 1.44 nA/CV respectively (see sections 4.1 and 4.2 on page 6, of the contested decision). These calculations have not been contested by the Appellant and show that the DC leakages of the anodes of D1 and D4 fall within the claimed range of less than 5.0 nA/CV.

5.2 Distinguishing Feature

According to the results given in the Table in column 13 (lines 1 to 6), the anode of D1 has a capacitance of 16,420 µC/g (a unit that corresponds to CV/g, as used in claim 1) and the anode of D4 has a capacitance of 7,480 CV/g (see Table 8-1 of D4). Hence the anode of claim 1 differs from those of D1 and D4 in that the capacitance, defined as being in the range 30,000 to 61,000 CV/g, is significantly greater.

5.3 Objective Problem

Starting from the niobium anodes of either D1 or D4, the objective problem to be solved is to increase the capacitance whilst maintaining low DC leakage.

5.4 Solution

5.4.1 The Board agrees with the submission of the Respondent that it is the normal aim of the skilled person to strive for improvements in capacitance and leakage, but the question remains as to how can these properties be improved.

Capacitance and leakage are generally contradictory in that any measure taken to improve one results in deterioration of the other. Factors which affect these properties include the surface area of the powder, its purity (in particular the oxygen content), the electrolyte composition, the formation voltage and temperature, and the sintering conditions; the skilled person thus has many parameters at his disposal which influence the properties of capacitor anodes.

The Respondent argues the effects of these parameters are known and in merely applying them to modern powders results in the desired properties. Nevertheless, in assessing inventive step in this case, the question to be answered is whether or not there is any indication in the prior art that would guide the skilled person to increase the capacitance of the anodes disclosed in D1 and D4 whilst maintaining their low leakage.

5.4.2 Document X3

Document X3 is an article directed to the suitability of niobium as a capacitor anode, and in particular concerns the influence of formation voltage and temperature and sintering conditions on DC leakage and capacitance. Table II gives the results of the formation voltage and temperature tests and the lowest DC leakage given is 0.025 µA/(µF-v), which corresponds to 25 nA/CV. Table III relates to the results of the sintering tests, and there the lowest value is 0.058 µA/(µF-v) or 58 nA/CV. It is thus clear that the anodes of X3 have a much higher DC leakage than is defined in claim 1.

Figures 1 and 3 of X3 show a linear relationship between the inverse capacitance per unit area and the formation voltage. The Appellant explained that capacitance calculated as CV/g, as is given in claim 1, corresponds to the constant slope of these graphs, so that if CV/g is plotted against formation voltage for the values given in X3, the value for capacitance remains constant. Hence Figures 1 and 3 do not show that CV/g increases as the formation voltage is reduced. The sintering results in Table III show the generally known effect that as sintering temperature increases DC leakage is reduced, whilst capacitance is reduced.

There is no clear teaching in X3 that capacitance can be increased whilst achieving the DC leakage values given in claim 1.

5.4.3 Document D7

D7 emphasises that the requirements of capacitance and leakage are contradictory; this is mentioned, for example, at column 1, lines 24 to 42 in respect of sintering conditions. The document also looks at the effects of carbon and oxygen content, but there is no indication that the properties given in claim 1 can be achieved.

5.4.4 Document D5

D5 discloses a value of 25,000 CV/g (see Table 1) that comes closest to the claimed value for capacitance (30,000 to 61,000 CV/g), but, as argued by the Appellant, this is a theoretical value based on corresponding tantalum particles. D5 does not provide any information about the corresponding DC leakage values.

5.4.5 Document D11

D11 is a scientific article examining the relationship between the specific charge and porous structure of niobium anodes. A relatively low sintering temperature of 1200°C is disclosed, as are formation voltages of 60V and less. However, there is no mention of DC leakage, and no indication of the combination of properties defined in claim 1.

5.5 Disclosure of the Technical Effect

5.5.1 The Respondent argues that claim 1 merely sets out the problem to be solved, and that there is no indication

in the patent specification that the desired combination of properties can be achieved. In particular, the Respondent points out that there is no example showing the combination of properties defined in claim 1.

5.5.2 Paragraph [0007] of the patent specification describes the object of the patent as being to provide capacitor anodes that have low DC leakages and high capacitances. Paragraph [0009] states that the former is achieved by starting from a powder having a certain BET surface area, and paragraph [0010] says that the latter is obtained through the combination of sintering conditions and the formation voltage. The examples in the patent specification show the effects of these process parameters. Despite failing to provide an example showing that both capacitance and DC leakage falling within the claimed ranges, the patent specification nevertheless shows that the posed problem can be credibly solved.

5.5.3 The Respondent submitted that the technical effect upon which the invention is based has not been shown in the patent specification, particularly as none of the Examples 5 to 8 show a capacitor anode having the claimed combination of properties. According to the Respondent, the properties defined in claim 1 merely amounts to a statement of the problem to be solved.

It may, or may not, be the case that carrying out the instructions given in the patent specification does not lead to the claimed invention. However, in the present case the missing values in the tables of Examples 5 to 8 do not indicate the absence of the inventive effect.

Rather, the specification discloses that by selecting particular values of the important parameters, ie specific surface area, oxygen content, sintering temperature and formation voltage, a capacitor anode having the claimed characteristics can be achieved. If this is to be contested, additional evidence, for example corresponding test results, should have been provided.

5.5.4 In addition, this is an objection that falls within the ambit of Article 100(b) EPC rather than lack of inventive step, ie the allegation is that, despite the instructions concerning particle size, formation voltage and sintering conditions, the patent specification nevertheless does not disclose the invention in a manner sufficiently clear and complete for it to be carried out by a person skilled in the art. Although this ground was raised in the opposition proceedings, it was not pursued in appeal, and consequently the Board is not competent to deal with this matter.

5.6 Summary

As argued by the Respondent, the effects of the various parameters, such as specific surface area, sintering temperature, formation voltage and oxygen content, on capacitance and DC leakage are generally known, and are discussed in the cited documents. However, there is no clear indication in the cited documents that directs the skilled person to create a capacitor anode based on niobium that has the combination of properties defined in claim 1. The disputed patent teaches that the advantageous combination of high capacitance and low

leakage can be obtained by selecting particular values of each of these parameters. For these reasons the claimed subject-matter has an inventive step.

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 29 of the second auxiliary request filed with the letter dated 7 May 2009 after any necessary adaption of the description and figures.

The Registrar: The Chairman:

A. Counillon U. Krause