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Datasheet for the decision of 23 April 2015

Case Number: T 2226/11 - 3.3.09

Application Number: 97200012.9

Publication Number: 0783960

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Language of the proceedings: EN

Title of invention:
Titanium-polymer hybrid laminates

Patent Proprietor:
The Boeing Company

Opponent:
AIRBUS Deutschland GmbH/AIRBUS France SAS/AIRBUS UK Limited/AIRBUS España S.L./AIRBUS SAS

Headword:

Relevant legal provisions:
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Case Number: T 2226/11 - 3.3.09

D E C I S I O N
of Technical Board of Appeal 3.3.09
of 23 April 2015

Appellant: (Patent Proprietor)	The Boeing Company 100 North Riverside Plaza Chicago, IL 60606-2016 (US)
Representative:	Land, Addick Adrianus Gosling Arnold & Siedsma Bezuidenhoutseweg 57 2594 AC Den Haag (NL)
Appellant: (Opponent)	AIRBUS Deutschland GmbH/AIRBUS France SAS/AIRBUS UK Limited/AIRBUS España S.L./AIRBUS SAS Kreetslag 10 21129 Hamburg (DE)
Representative:	Landry, Felix Uexküll & Stolberg Patentanwälte Beselerstrasse 4 22607 Hamburg (DE)
Decision under appeal:	**Interlocutory decision of the Opposition Division of the European Patent Office posted on 3 August 2011 concerning maintenance of the European Patent No. 0783960 in amended form.**

Composition of the Board:

Chairman	W. Sieber
Members:	W. Ehrenreich
	F. Blumer

Summary of Facts and Submissions

I. The appeals of the proprietor and the joint opponents concern the interlocutory decision of the opposition division to maintain European patent No. 0 783 960 in amended form on the basis of claims 1 to 15 of auxiliary request 3 filed in oral proceedings.

II. The patent was granted with 16 claims, claim 1 reading as follows:

"1. A hybrid laminate comprising:

a) a pair of layups, each comprising:

(i) a beta titanium alloy foil layer (10) comprising butt-joined foils each of thickness in the range from about 0.25 (0.01) to about 0.08 mm (0.003 inches) thick; and

(ii) a layer of polymeric composite bonded to a side of the foil layer, the layer comprising at least one ply (12, 14) comprising a matrix of a polymer, the polymer resistant to repeated exposure to temperatures of at least 175°C (350°F), the composite having parallel-oriented fibers embedded in the matrix; and

b) a central lightweight core structure (40) such as honeycomb core, one of the pair of layups bonded to each side of the core structure to form a symmetrical hybrid laminate."

Claims 2 to 11 were dependent claims. Claim 12 and dependent claims 13 to 16 were directed to an aircraft skin panel comprising

a) a central lightweight core structure (40) and

b) a layup bonded to an outer surface of the central lightweight core structure (40), the layup being defined by features (i) and (ii) according to claim 1.

III. The opposition was based on the grounds that the claimed subject-matter was neither novel nor inventive (Article 100(a) EPC), that the invention was insufficiently disclosed (Article 100(b) EPC) and that the patent contained subject-matter which extended beyond the content of the application as filed (Article 100(c) EPC).

The documents cited in the opposition proceedings included:

D1 NASA Contractor Report CR-1859: "Analytical and Experimental Investigation of Aircraft Metal Structures Reinforced with Filamentary Composites", Phase I (1971);

D2 NASA Contractor Report CR-2039: "Analytical and Experimental Investigation of Aircraft Metal Structures Reinforced with Filamentary Composites", Phase II (1972);

D3 NASA Technical Memorandum 109095: "Preliminary Evaluation of Hybrid Titanium Composite Laminates" (1994);

D5 W. Steven Johnson et al., "High Temperature Hybrid Titanium Composite Laminates: An Early Analytical Assessment", 10th International

Conference on Composite Materials ICCM-10, Whistler, Canada (1995);

D6 Metal Progress Databook, pp. 98/99 (1978);

E0 W.F. Smith, "Structure and Properties of Engineering Alloys", McGraw Hill Inc., p. 451 (1981);

E1 Declaration by W.N. Nestre dated 21 November 1997 including a graph ("Effect of Foil Thickness on UTS of TiGr Laminate");

E2 J.C. Fanning, "Timetal® 15-3 Property Data", Proceedings of a Symposium on Beta Titanium Alloys sponsored by the Titanium Committee of TMS, held at the 1993 Annual TMS Meeting in Denver, Colorado, February 22-24, 1993, p. 411;

E3 NASA Contractor Report D6-81883-2: "Development of Titanium-PMC Hybrid Laminates - Part Two", p. 34 (1996).

IV. The decision of the opposition division, announced orally on 26 May 2011 and issued in writing on 3 August 2011, was based on the main request (claims as granted) and auxiliary requests 1 to 3 filed in the oral proceedings. The opposition division held that the main request was not allowable since - *inter alia* - the feature "a central lightweight core structure (40) such as honeycomb core" in claim 1 as granted was disclosed in the application as filed solely in the context of titanium alloy materials (Article 100(c) EPC). In order to meet the objection under Article 100(c) EPC each claim 1 of auxiliary requests 1 and 2 had been amended to refer to "a central lightweight core structure (40)

such as titanium alloy honeycomb material". However, auxiliary requests 1 and 2 were not allowed because the subject-matter of their claim 1 did not involve an inventive step when starting from D1 as the closest prior art.

The subject-matter of auxiliary request 3 was considered to meet the requirements of the EPC. Claim 1 of this request read as follows:

"A hybrid laminate comprising:

a) a pair of layups, each comprising:

(i) beta titanium alloy foil layers (10), each of which comprising butt-joined foils each of thickness in the range from about 0.25 mm (0.01 inch) to about 0.08 mm (0.003 inches) thick; and

(ii) layers of polymeric composite, each of which is bonded to a side of the foil layer, the layer comprising at least one ply (12, 14) comprising a matrix of a polymer, the polymer resistant to repeated exposure to temperatures of at least 175°C (350°F), the composite having parallel-orientated fibers embedded in the matrix; wherein the beta titanium alloy foil layers alternate with the polymeric composite layers, and

b) a central lightweight core structure (40), such as titanium alloy honeycomb material, one of the pair of layups bonded to each side of the core structure layer to form a symmetrical hybrid laminate; wherein the outer surface of the hybrid laminate is of a beta titanium alloy foil."

The opposition division decided that the subject-matter of this claim was novel over the disclosure in D1 and D2, and involved an inventive step in the light of D1 as the closest prior art taken either alone or in combination with D3 and/or D5.

V. On 13 October 2011 both the proprietor and the joint opponents filed an appeal.

As the proprietor and the joint opponents are respectively appellant(s) and respondent(s) in these proceedings, for simplicity the board will continue to refer to them as the proprietor and the opponents.

VI. In the statement of grounds of appeal filed on 12 December 2011 the proprietor requested that the appealed decision be set aside and that the patent be maintained on the basis of auxiliary request 1 or auxiliary request 2, both filed in the oral proceedings before the opposition division. With the letter dated 25 April 2012 the proprietor requested that the opponents' appeal be dismissed, i.e. that the patent be maintained as allowed by the opposition division on the basis of auxiliary request 3. With the same letter a further set of claims for auxiliary request 4 was filed.

VII. On 9 December 2011 the opponents filed their statement of grounds of appeal. With the letter dated 26 April 2012 they responded to the proprietor's appeal and maintained their previous objections raised under Article 100(a), (b) and (c) EPC.

VIII. On 10 February 2015 the board issued a communication and gave its preliminary opinion on the objections

raised under Articles 100(a), (b) and (c) EPC. As to the question of inventive step, the board confirmed that D1 represented the closest prior art and expressed its view that a combination of D1 with either D3, D5 or D6 should be taken into account for the assessment of inventive step.

IX. The opponents responded with letter of 20 March 2015.

X. With its letter dated 14 April 2015 the proprietor filed further sets of claims for auxiliary requests 5 and 6 and presented a declaration by R. Boyer dated 8 April 2015.

XI. Oral proceedings took place on 23 April 2015. During the hearing, the question of novelty and added subject-matter with respect to claim 1 of auxiliary request 1 was discussed first. The main discussion, however, focused on the question of inventive step of the subject-matter of claims 1 of the proprietor's auxiliary requests 1 to 6. The proprietor's auxiliary request 7 submitted during the oral proceedings was not admitted.

XII. Because inventive step was decisive for the subject-matter of all requests, namely auxiliary requests 1 to 6, the parties' arguments summarised in the following are confined to this issue.

XIII. Arguments of the opponents

Auxiliary request 1

Apart from the reference to "a central lightweight core structure (40), such as **titanium alloy** honeycomb material" (emphasis added), claim 1 of auxiliary

request 1 corresponds to claim 1 as granted. When starting from D1 as the closest prior art, the only difference between the claimed hybrid laminate and the honeycomb sandwich panel described in figure 37 at page 71 of D1 is the use of a beta Ti-alloy foil instead of a Ti-6Al-4V alloy foil which is an alpha-beta Ti-alloy.

No technical effect has been shown which could be attributed to the use of a beta Ti-alloy. Documents E0 to E3 do not show such an effect. Thus, the problem to be solved by the distinguishing feature consists only in the provision of an alternative hybrid laminate structure.

D5 is concerned with the use of thin high-temperature titanium composite laminates for aircraft applications in the high-speed area, composed of thin titanium sheets bonded together with a polymer composite prepreg consisting of a high-temperature resin reinforced with high modulus fibres. It is indicated in Table 1 at page 3 that beta Ti-alloys are suitable as thin sheets for these purposes. Also D6 (enlarged copy of the document presented in the oral proceedings) indicates at the end of page 99 that beta Ti-alloys are "high strength fasteners" and are used in aerospace components and honeycomb panels.

Thus, a combination of D1 with either D5 or D6 renders the claimed subject-matter obvious.

Auxiliary request 2

It is an additional requirement in claim 1 of auxiliary request 2 that the outer surface of the hybrid laminate is of a beta Ti-alloy foil. The position of the Ti-alloy foil outside the hybrid laminate is, however, a

feature of the honeycomb sandwich panel depicted in figure 37 of D1. Therefore, similar arguments as for auxiliary request 1 apply for the subject-matter of claim 1 of auxiliary request 2.

Auxiliary request 3

In essence, claim 1 of auxiliary request 3 differs from claim 1 of auxiliary request 2 by the further requirement that the beta Ti-alloy foil layers alternate with the polymeric composite layers (for the exact wording see point IV above). However, no specific technical effect has been shown for this embodiment. Thus, the problem to be solved resides in the provision of an alternative hybrid laminate.

Figure 1 of D5 shows a hybrid titanium composite laminate wherein the Ti-alloy foils alternate with the polymeric fibre prepreg layers. Thus, a combination of D1 with D5 also renders the subject-matter of claim 1 of this request obvious.

Auxiliary requests 4 to 6

Claims 1 of auxiliary requests 4 to 6 characterise the hybrid laminate by structural elements which are in essence identical to those indicated in claim 1 of auxiliary request 3 (one particular amendment in part b) of claim 1 concerns replacement of the wording for the optional feature "such as titanium alloy honeycomb material" according to auxiliary request 3 with "such as honeycomb core" in auxiliary requests 4 to 6). Thus, the arguments provided for auxiliary request 3 also apply for auxiliary requests 4 to 6.

XIV. Arguments of the proprietor

Auxiliary request 1

The honeycomb sandwich panels described in D1 all use an alpha-beta Ti-alloy foil. This was mainstream at the time when D1 was drafted (1971). Beta Ti-alloys were not used in the 1970s. This view is corroborated by E0 which indicates that the metastable beta Ti-alloys were not used much at that time (i.e. in 1981). Furthermore, Mr. Boyer who was a widely recognised specialist with long experience in Ti-alloys confirms in his declaration dated 8 April 2015 that it was not to be expected by an average skilled person at the time of the 1996 priority date that thin layers of beta Ti-alloy foils ranging from about 0.01 inch to about 0.003 inch thickness and bonded between layers of polymeric composite and as layups bonded to a honeycomb core would improve such hybrid laminates.

In contrast, pages 17/18 of the application as filed point to a number of advantages, like open-hole tensile/compressive strength and ultimate tensile/compressive strength. These properties are not mentioned in D5. The skilled person has thus no incentive to combine D1 with D5 in order arrive at a honeycomb structure having the above advantageous properties.

Auxiliary request 2

The further feature of claim 1 that the outer surface of the hybrid laminate is of beta Ti-alloy foil is important for the kerosene resistance of fuel tanks, which are normally positioned in the wings of an

aircraft. There is nothing in D5 which would incite the skilled person to use a beta Ti-alloy for this purpose.

Auxiliary request 3

The additional feature of an alternating arrangement of the beta Ti-alloy foils and the polymeric composite layers according to claim 1 leads to improvements in ultimate tensile strength, ultimate compressive strength and open hole strength which make the hybrid laminate suitable for supersonic aircraft, as indicated on pages 17/18 in conjunction with figure 5 of the application as filed. This effect was acknowledged as support for inventive step by the opposition division in its decision.

Although D5 depicts in figure 1 an alternating structure, there is no reference to the above properties, and thus no incentive exists for a skilled person to combine D5 with D1 in order to arrive at the subject-matter of claim 1.

Auxiliary requests 4 to 6

No further arguments were put forward by the proprietor as regards inventive step.

XV. Final requests

The opponents requested that the decision under appeal be set aside and that the patent be revoked.

The proprietor requested that the decision under appeal be set aside and that the patent be maintained on the basis of auxiliary request 1 or, alternatively, on the basis of auxiliary request 2, both filed on 26 May 2011

during oral proceedings before the opposition division, or that the opponents' appeal be dismissed, i.e. that the patent be maintained on the basis of auxiliary request 3 as allowed by the opposition division, or that the patent be maintained on the basis of one of auxiliary request 4 as filed with letter dated 25 April 2012 or auxiliary requests 5 and 6 as filed with letter dated 14 April 2015 or auxiliary request 7 as filed during the oral proceedings before the board.

Reasons for the Decision

1. The appeals are admissible.

2. Auxiliary request 1

2.1 Claim 1 reads as follows:

"1. A hybrid laminate comprising:

a) a pair of layups, each comprising:
(i) a beta titanium alloy foil layer (10) comprising butt-joined foils each of thickness in the range from about 0.25 (0.01) to about 0.08 mm (0.003 inches) thick; and
(ii) a layer of polymeric composite bonded to a side of the foil layer, the layer comprising at least one ply (12, 14) comprising a matrix of a polymer, the polymer resistant to repeated exposure to temperatures of at least 175°C (350°F), the composite having parallel-orientated fibers embedded in the matrix; and

b) a central lightweight core structure (40), such as titanium alloy honeycomb material, one of the pair of layups bonded to each side of the core

structure layer to form a symmetrical hybrid laminate."

2.2 At the beginning of the oral proceedings the amendments in claim 1 and the issue of novelty of the claimed subject-matter were discussed.

The board accepted the proprietor's view that the combination of the thickness range for the beta Ti-alloy foils (0.01 to 0.003 inches) with the requirement that the foils are butt-joined has a basis in the application as filed, so that the requirements of Article 123(2) EPC are met.

The board also agreed with the proprietor that it was accepted in the prior art that an alpha-beta Ti-alloy is different from a beta Ti-alloy. Therefore the subject-matter of claim 1 is novel over D1.

Since however, as set out below, auxiliary request 1 is not allowable for lack of inventive step, there is no need to discuss these issues further.

2.3 Inventive step

2.3.1 The patent is concerned with supersonic aircraft skin panels of a hybrid laminate structure including a central core layer having bonded to each side a layup (paragraph [0001] of the patent specification). According to paragraph [0006] the laminate should meet the requirements of strength, modulus, fatigue resistance and thermo-mechanical endurance.

2.3.2 The closest prior art is represented by D1. This document discloses analytical and experimental investigation of aircraft metal structures reinforced

with filamentary composites. As set out in the summary, the following systems were investigated:

- aluminum-boron-epoxy,
- titanium-boron-epoxy, and
- titanium-boron-polyimide.

In particular the titanium-boron-polyimide laminate system was evaluated for supersonic aircraft at a temperature range of -54°C to +233°C (page 3, "Introduction", paragraph 5).

A symmetrical honeycomb sandwich assembly is schematically depicted in figure 37 at page 71. The assembly includes

- a central honeycomb core structure
- a boron fibre-reinforced polymeric composite, symmetrically bonded to both sides of the honeycomb structure, and
- a Ti-6Al-4V alloy foil, i.e. an alpha-beta Ti-alloy foil layer, having a thickness of 0.010 inches and positioned at the outer surfaces of the symmetrical structure

2.3.3 The proprietor saw the problem to be solved in the light of D1 in the provision of a hybrid laminate structure having improved mechanical properties such as open-hole compressive strength or open-hole tensile strength and ultimate tensile strength at reduced thickness of the structure.

2.3.4 As a solution to the above problem, claim 1 proposes, unlike the assembly depicted in figure 37 of D1, to use a beta Ti-alloy foil instead of an alpha-beta Ti-alloy foil.

2.3.5 Neither the patent specification nor documents E0 to E3 show, e.g. by way of comparative tests, a specific technical effect due to the replacement of an alpha-beta Ti-alloy foil according to D1 with a beta Ti-alloy foil. Although E1 depicts a graph showing an increase of the ultimate tensile strength at a decreasing thickness of the Ti-foil layer within the claimed range, there is no direct comparison derivable therefrom between an alpha-beta Ti-alloy foil and a beta Ti-alloy foil.

It is further to be noted that there is no indication in the application as filed that the properties of high open-hole tensile and compressive strength as well as ultimate tensile and compressive strength mentioned on pages 17/18 of the description are unambiguously linked to the presence of a beta Ti-alloy foil. Original claim 1 simply indicates in feature (i) that the metal foil comprises titanium and page 6, lines 17 to 21 even states that aluminium and aluminium alloy foils or titanium and its alloys may also be used. Although a beta Ti-alloy foil is said to be most preferred, no specific technical effect is attributed to the use of this alloy.

2.3.6 Thus, a less ambitious problem has to be formulated, which is seen in the provision of an alternative hybrid laminate.

2.3.7 D5 is a paper which presents a new type of material system that shows great promise for aerospace applications. The concept consists of thin sheets of titanium bonded together with a polymer composite prepreg reinforced with high or intermediate modulus fibres resulting in a high-temperature titanium hybrid

composite laminate (abstract and introduction). In the second paragraph at page 2 it is mentioned that future aircraft, both military and commercial, are being designed to reach higher speeds and be more durable than ever before. To meet the design criteria for such aircraft, the structural materials must be capable of extended use at elevated temperature while exhibiting improved damage resistance and tolerance. According to the section "Materials" at page 3, "Ti-15-3" and "Timetal 21S", which are both beta Ti-alloys, can be used for making hybrid titanium composite laminates (HTCL). As can be seen from Table 1 at page 3, the beta Ti-alloy foil "Timetal 21S" has properties in long modulus, transition modulus, shear modulus, yield strength and ultimate strength which are comparable to those of "Ti-6-4", which is an alpha-beta Ti-alloy foil.

The suitability of beta Ti-alloys as high-strength fasteners for aerospace components and honeycomb panels is also confirmed by D6 (last section of the Table at page 99).

2.3.8 The skilled person starting from the symmetrical hybrid laminate shown in figure 37 of D1, including a honeycomb core structure, and looking for an alternative hybrid laminate structure is thus prompted, in the light of the positive evaluation in D5 and D6 of the suitability of beta Ti-alloys for aircraft applications, to try to find out whether the alpha-beta Ti-alloy foil of D1 can be successfully replaced with a beta Ti-alloy foil.

2.3.9 The proprietor argued with respect to E0 (page 451 under "Chemical Compositions and Typical Applications") and the declaration dated 8 April 2015 by R. Boyer, an

expert in the development of hybrid laminate structures including a Ti-alloy foil, that the use of beta Ti-alloys was unusual at the priority date. On the other hand, D5 and D6 are prior art before the priority date and point towards the use of beta Ti-alloys. Therefore there was a strong incentive for a skilled person to use beta Ti-alloy foils as an alternative to alpha-beta Ti-alloy foils. The proprietor's argument is thus not convincing.

2.3.10 The subject-matter of claim 1 of auxiliary request 1 therefore does not involve an inventive step with regard to a combination of D1 with D5 and/or D6.

2.3.11 Because the subject-matter of claim 1 lacks an inventive step, auxiliary request 1 is not allowable.

3. Auxiliary request 2 - inventive step

3.1 Compared with claim 1 of auxiliary request 1, claim 1 of auxiliary request 2 requires, as an additional feature, that the outer surface of the hybrid laminate is of a beta Ti-alloy foil.

3.2 The proprietor argued in this respect that this requirement was important for resistance to kerosene, in particular when the hybrid laminate was used for making the fuel tanks of an aircraft positioned in its wings. This argument cannot, however, support an inventive step over a combination of D1 with D5 and/or D6 because the position of the Ti-alloy foil at the outer surface of the hybrid laminate is already a feature of the disclosure of D1. The proprietor has not shown that a beta Ti-alloy foil shows improved kerosene resistance over an alpha-beta Ti-alloy foil as used in D1.

3.3 Thus, the same arguments as those given above for the subject-matter of claim 1 of auxiliary request 1 also apply for auxiliary request 2.

3.4 Auxiliary request 2 is therefore not allowable for lack of inventive step of the subject-matter of claim 1.

4. Auxiliary request 3

4.1 Basically, claim 1 of auxiliary request 3 differs from claim 1 of auxiliary request 2 in that the beta titanium foil layers alternate with the polymeric composite layers.

4.2 Such an alternating structure of polymeric composite layers with Ti-alloy foil layers is already disclosed in figure 1 at page 2 of D5. With reference to this figure 1, the text passage in the last paragraph of the preceding page indicates that such a structure is part of the new concept for making high-temperature titanium hybrid composite laminates.

In so far as the proprietor referred to improved properties like open-hole compressive strength and ultimate tensile strength as disclosed on pages 17/18 of the description as filed in the context of the alternating structure, the board notes that this disclosure does not directly link these properties with the requirement of an alternating structure. If anything, the relevant passages in the application as filed disclose that these properties depend on the composite volume fraction (paragraph bridging pages 17 and 18) or the type of the reinforcing fibre in the polymeric composite (page 18, second paragraph). Such features, however, are not part of claim 1.

4.3 Thus, a combination of D1 with D5 also renders the subject-matter of claim 1 of auxiliary request 3 obvious. Auxiliary request 3 is therefore not allowable.

5. Auxiliary requests 4 to 6

5.1 Apart from the fact that claim 1 of auxiliary request 4 again refers to "a central lightweight core structure (40) such as honeycomb core" as opposed to "titanium alloy honeycomb material" [apparently this amendment has inadvertently not been taken over from the previous requests], this claim merely contains a slight re-wording of features (i) and (ii). However, in essence features (i) and (ii) have the same technical meaning as in claim 1 of auxiliary request 3. Thus, the same arguments given in points 4.2 and 4.3 above are also applicable for claim 1 of auxiliary request 4.

5.2 Claims 1 of auxiliary requests 5 and 6 are identical to claim 1 of auxiliary request 4. The essential difference between these requests lies merely in the wording of dependent claims 3 in auxiliary requests 4 and 5, relating to the thickness of the ply forming the layers of polymeric composite (ii) and the deletion of a corresponding claim in auxiliary request 6.

5.3 Therefore auxiliary requests 4 to 6 are not allowable for the same reasons as those given for auxiliary request 3.

6. Auxiliary request 7

6.1 During the oral proceedings the proprietor presented a new auxiliary request 7. Claim 1 of this request was

based on claim 1 of auxiliary request 3 including the following limitation of feature (b):

"(b) a central lightweight core structure (40) being of titanium alloy honeycomb material ...".

In contrast thereto, titanium alloy honeycomb material was only optional in claim 1 of auxiliary request 3 ("..., such as ... honeycomb material ...").

6.2 This amendment shifts the case to new subject-matter which has never been discussed before in either the opposition or the appeal proceedings. Thus, discussion of this new subject-matter under the provisions of Article 56 EPC would raise new questions and require new arguments, possibly with reference to new documents, which neither the opponents nor the board could reasonably be expected to deal with without adjournment of the oral proceedings.

6.3 The board therefore exercises its discretion not to admit auxiliary request 7 into the proceedings (Articles 13(1) and 13(3) of the Rules of Procedure of the Boards of Appeal).

7. From points 2 to 6 it follows that none of the proprietor's requests justifies the maintenance of the patent.

Order

For these reasons it is decided that:

1. The decision under appeal is set aside.

2. The patent is revoked.

The Registrar: The Chairman:

D. Hampe W. Sieber

Decision electronically authenticated