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**Datasheet for the decision
of 15 February 2017**

Case Number: T 1269/15 - 3.3.09
Application Number: 02739835.3
Publication Number: 1404517
IPC: B32B15/04, B32B9/00, C25D11/02,
B22F3/00, C04B37/02
Language of the proceedings: EN

Title of invention:

APPLICATION AND MANUFACTURING METHOD FOR A CERAMIC TO METAL
SEAL

Applicant:

Alfred E. Mann Foundation for Scientific Research

Headword:

Relevant legal provisions:

EPC Art. 54, 56

Keyword:

Amendments - added subject-matter (no)
Clarity - (yes)
Novelty - (yes)
Inventive step - (yes)

Decisions cited:

Catchword:



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Boards of Appeal
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Case Number: T 1269/15 - 3.3.09

D E C I S I O N
of Technical Board of Appeal 3.3.09
of 15 February 2017

Appellant:
(Applicant)

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Decision under appeal:

**Decision of the Examining Division of the
European Patent Office posted on 30 January 2015
refusing European patent application No.
02739835.3 pursuant to Article 97(2) EPC.**

Composition of the Board:

Chairman J. Jardón Álvarez
Members: N. Perakis
F. Blumer

Summary of Facts and Submissions

I. This decision concerns the appeal filed by the applicant (in the following: the appellant) against the decision of the examining division refusing European patent application No. 02739835.3. The claims concerned were those filed with letter dated 17 July 2014. Independent claims 1 and 7 read as follows:

"1. A component assembly (2) for producing a bonded component assembly for implantation in living tissue, the component assembly comprising:
a ceramic part (6),
a metal part (4),
an essentially pure nickel interlayer material (8) for solid state bonding said ceramic part to said metal part, said interlayer material consisting of pure nickel or nickel containing two percent or less by weight of alloy metals and being located between and in contact with said ceramic part and said metal part, wherein said interlayer material is suitable for reacting with and forming a eutectic bond between said metal part and said ceramic part".

"7. A method of hermetically sealing a ceramic and metal component assembly for implantation in living tissue, comprising the steps of:
selecting a ceramic part (6);
selecting a metal part (4);
selecting an essentially pure nickel interlayer material (8) that is compatible with said ceramic part, said essentially pure interlayer material consisting of pure nickel or nickel containing two percent or less by weight of alloy metals and being one which forms a eutectic alloy with said metal part, said eutectic alloy consisting predominately of metal of said metal

part and having a eutectic melting point temperature that is lower than the respective melting points of said metal or of said pure interlayer material; positioning said pure interlayer material between said ceramic part and said metal part; applying a force to said ceramic part and said metal part to place said pure interlayer material in compression, thereby creating intimate contact between said ceramic part, said metal part and said pure interlayer material so as to form an assembly; placing said assembly in a non-reactive atmosphere; heating said assembly to a bonding temperature equal to said eutectic melting point; and holding the assembly at said bonding temperature for a predetermined time to form a bond between said ceramic part and said metal part."

II. The decision refusing the application was based on the state of the file, as requested by the appellant, with reference to the communication of the examining division dated 26 September 2014. In that communication the examining division considered that at least the subject-matter of independent claim 1 (product claim) and independent claim 7 (method claim) lacked novelty over D12 and D13, considered individually. The examining division further noted that the claimed subject-matter lacked inventive step in view of D2.

D2 : US 6 221 513 B1;
D12: GB 833 743 A; and
D13: GB 813 829 A.

III. The statement setting out the grounds of appeal was filed on 9 June 2015. The appellant requested that the examining division's decision be set aside and that a patent be granted on the basis of the claims pending

before the examining division (main request re-filed) or on the basis of the sets of claims according to any of the three new auxiliary requests filed with the grounds of appeal.

- IV. With a communication dated 2 January 2017, the board gave its preliminary opinion on clarity, added subject-matter and novelty in respect of the appellant's requests.
- V. By letter of 30 January 2017, the appellant submitted a fourth auxiliary request in reply to the board's communication.
- VI. Oral proceedings took place before the board on 15 February 2017. During these oral proceedings the appellant withdrew all previous requests and filed a new main request and a description adapted thereto. Independent claims 1 and 5 of this request read as follows:

"1. A component assembly (2) for producing a bonded component assembly for implantation in living tissue, the component assembly comprising:
an yttria-stabilized zirconia ceramic part (6),
a titanium alloy metal part (4),
a nickel interlayer material (8) for solid state bonding said ceramic part to said metal part, said interlayer material consisting of nickel or nickel containing two percent or less by weight of alloy metals and being located between and in contact with said ceramic part and said metal part,
wherein said interlayer material is suitable for reacting with and forming a eutectic bond between said metal part and said ceramic part."

"5. A method of hermetically sealing a ceramic and metal component assembly for implantation in living tissue, comprising the steps of:
selecting an yttria-stabilized zirconia ceramic part (6);
selecting a titanium alloy metal part (4);
selecting a nickel interlayer material (8) that is compatible with said ceramic part, said interlayer material consisting of nickel or nickel containing two percent or less by weight of alloy metals and being one which forms a eutectic alloy with said metal part, said eutectic alloy consisting predominately of metal of said metal part and having a eutectic melting point temperature that is lower than the respective melting points of said metal or of said pure interlayer material;
positioning said interlayer material between said ceramic part and said metal part;
applying a force to said ceramic part and said metal part to place said pure interlayer material in compression, thereby creating intimate contact between said ceramic part, said metal part and said interlayer material so as to form an assembly;
placing said assembly in a non-reactive atmosphere;
heating said assembly to a bonding temperature greater than or equal to said eutectic melting point; and
holding the assembly at said bonding temperature for a predetermined time to form a bond between said ceramic part and said metal part by solid state bonding, wherein said bonding temperature is between 942°C (1728°F) to 982°C (1800°F)."

The appellant requested that the decision under appeal be set aside and that a patent be granted on the basis of the new main request and the description adapted thereto.

VII. The arguments presented by the appellant in its written submissions and at the oral proceedings may be summarised as follows:

- The subject-matter of the claims of the new main request found support in the application as published and therefore fulfilled the requirements of Article 123(2) EPC.
- The subject-matter of the claims also fulfilled the requirement of clarity since the objections raised by the board had been overcome.
- The component assembly of claim 1 differed from the component assembly of both D12 and D13 in view of the ceramic material used and the assembly's suitability for implantation in living tissue. Furthermore, it differed from D2 in the interlayer material used. Thus, the claimed subject-matter was novel over those documents.
- D2 was considered to be the closest prior art, as it related to implantable devices. The difference between the assembly claimed and that of D2 was the type of interlayer material used. However, the skilled person would not have found any hint in the prior art to replace the titanium-nickel alloy interlayer of D2 by the claimed nickel interlayer, which had been known to be harmful to living tissue. Furthermore, the skilled person would not have considered D12 or D13, which disclosed nickel as the interlayer material, since these documents did not concern biocompatible devices but vacuum tubes/triodes which were unsuitable for use in living tissue, in particular because nickel could

be squeezed out from between the ceramic and metal members.

Reasons for the Decision

1. Amendments

The board acknowledges that the subject-matter of the claims of the appellant's new main request, filed during the oral proceedings before the board, directly and unambiguously derives from the application as published (WO 02/102589 A1) and therefore fulfils the requirements of Article 123(2) EPC. More specifically:

- Independent product claim 1 is now directed to the preferred embodiment disclosed on pages 2 and 3 of the application as published. It results from the combination of claim 1 as published with
 - the features defining the ceramic part and metal part from the description as published (page 2, line 4),
 - the features defining the nickel interlayer from the description as published (page 2, lines 7-10 and 29-30; page 6, lines 16-18) and claim 4 as published, and
 - the features defining the intended use for producing a bonded component assembly for implantation in living tissue from the description as published (page 3, lines 3-5).

- The additional features of:
 - dependent claim 2 are disclosed in claim 5 as published and the description as published (page 2, lines 20 to 23);

- dependent claim 3 are disclosed in claims 6 and 7 as published and the description as published (page 2, line 7); and
 - dependent claim 4 are disclosed in claim 8 as published and the description as published (page 2, line 7).
-
- Independent method claim 5 results from the combination of claim 9 as published with
 - the features defining the ceramic part and metal part from the description as published (page 2, line 4),
 - the features defining the nickel interlayer from the description as published (page 2, lines 7-10 and 29-30; page 6, lines 16-18) and claim 4 as published,
 - the features defining the intended use for producing a bonded component assembly for implantation in living tissue from the description as published (page 3, lines 3-5), and
 - the feature defining the bonding temperature from the description as published (page 2, lines 10-14).
-
- The additional features of dependent claims 6 to 17 of the main request are disclosed in the following claim as published:
 - dependent claim 6 in claim 10;
 - dependent claim 7 in claim 11;
 - dependent claim 8 in claim 16;
 - dependent claim 9 in claim 17;
 - dependent claim 10 in claim 18;
 - dependent claim 11 in claim 19;
 - dependent claim 12 in claim 20;
 - dependent claim 13 in claim 21;

- dependent claim 14 in claim 23;
- dependent claim 15 in claim 24;
- dependent claim 16 in claim 25; and
- dependent claim 17 in claim 26.

In summary, all claims of the new main request find support in the application as filed.

2. Clarity

In its communication of 2 January 2017 the board raised clarity objections against the subject-matter of the claims of the requests of the appellant filed with the statement setting out the grounds of appeal. These objections do not apply to the subject-matter of the claims of the new main request, which fulfils the requirements of Article 84 EPC.

3. Novelty

3.1 Documents D12 and D13 were cited by the examining division as relevant for novelty of the then claimed subject-matter.

3.1.1 D12 discloses vacuum-tight seals suitable for the manufacture of valves for very short waves (page 2, lines 20-23). Such a seal is formed between a metal object, such as a titanium or zirconium object, and a ceramic surface, which consists preferably of alumina, with the interposition of an intermediate metal, such as nickel. The intermediate metal forms a eutectic alloy with the metal of the metal object when the temperature is raised in vacuum to an extent such that the intermediate metal melts owing to the titanium or zirconium dissolved therein and adheres to the ceramic surface (page 1, lines 9-10, 32-42, 48-49; claim 1).

- 3.1.2 D13 discloses vacuum tubes (page 3, lines 28-29) which are manufactured by a method involving hermetically bonding together the surfaces of a metal member, such as a titanium tube, and a ceramic member by means of a metal shim, such as nickel, when heating them in a non-reactive atmosphere to a temperature at least equal to the melting point of the eutectic alloy formed from the metal member and the shim, such as 955°C, resulting in the formation in place of a molten reactive alloy which wets the surface of the ceramic body and which on cooling provides a bond (page 1, line 79 to page 2, line 6; page 2, lines 46-58; claim 1). The ceramics frequently used are corundum, forsterite, stearite, beryllia and zircon (page 3, lines 80-83 and table II).
- 3.1.3 The subject-matter of claim 1 of the new main request is novel over the disclosures of D12 and D13 at least because the ceramic part is an yttria-stabilised zirconia which is disclosed neither in D12 nor in D13. The subject-matter of independent claim 5, relating to a method of hermetically sealing a ceramic and metal component assembly, is novel for the same reason. The subject-matter of the dependent claims, which relate to specific embodiments of the independent claims are novel *mutatis mutandis*.
- 3.2 The examining division also made reference to D2 as a relevant document.
- 3.2.1 D2 discloses a component assembly for producing a bonded component assembly to be used in implantable medical devices which comprises (i) a ceramic material corresponding to the claimed ceramic part (6), (ii) a metallic material corresponding to the claimed metallic

part (4) and (iii) a sealing alloy corresponding to the claimed interlayer material (column 1, lines 7-12). D2 discloses various ceramic materials, including the claimed zirconia stabilized with yttria (column 2, lines 38-41, and column 5, line 6).

D2 also discloses that the metallic material is preferably a titanium-niobium or titanium-tantalum alloy, i.e. a titanium alloy according to claim 1 (column 2, lines 46-53).

D2 further discloses that the sealing alloy (interlayer material) is a titanium-nickel alloy with preferably at least 35% titanium, most preferably a 50%-50% titanium-nickel alloy (column 2, lines 54-62; column 5, lines 27-30).

- 3.2.2 The subject-matter of claim 1 differs from the disclosure of D2 in that yttria-stabilized zirconia has to be selected from the list of ceramics of D2 and in that the interlayer material is either nickel or a nickel alloy containing two percent or less by weight of alloy metals (selection from a broad range). The latter satisfies the requirements established by the case law of the boards of appeal (see Case Law of the Boards of Appeal of the EPO, 8th edition 2016, I.C.6.3.1) in that it is narrow (two percent or less by weight), far removed from the preferred range of D2 (at least 35% nickel) and purposive (for solid-state bonding). Thus, the subject-matter of claim 1 is novel over D2. Claim 5, which concerns a method of hermetically sealing a ceramic and metal component assembly, is novel for the same reasons. The subject-matter of the dependent claims, which relate to specific embodiments of the independent claims are novel *mutatis mutandis*.

4. Inventive step

4.1 The board concurs with the appellant that D2 is the closest prior-art document since it relates to the technical field of the present patent application, namely the manufacture of a ceramic-to-metal seal for applications such as implantable medical devices, which means that the device has to be biocompatible for implantation in living tissue.

4.2 The component assembly of claim 1 differs from that of D2 in that it uses yttria-stabilized zirconia as the ceramic part and uses nickel or a nickel alloy containing two percent or less by weight of alloy metals as the interlayer material (see above, point 3.2.2). Regarding the latter, D2 teaches to use as an interlayer material nickel-titanium alloys with a nickel content of preferably at least 35%, most preferably of 50%:50%.

4.3 According to the appellant, the technical problem underlying the claimed invention in view of D2 is the provision of an alternative component assembly for producing a bonded component assembly for implantation in living tissue with an interlayer material which does not leak out of the assembly.

4.4 The solution is provided by combination of the materials of claim 1, wherein yttria-stabilized zirconia is chosen for the ceramic part, titanium alloy for the metal part and nickel or nickel containing two percent or less by weight of alloy metals for the interlayer material. This allows a lower temperature for bonding to be used, namely 942-982°C (1728-1800°F), to avoid melting of the interlayer at this temperature

and to preserve the original pre-bond dimensions during the bonding process (application as published: page 2, lines 11-14 and 24-31).

- 4.5 The skilled person starting from D2 and aiming at an alternative component assembly to be used for implantation in living tissue with an interlayer material which does not leak out of the assembly would not find in D2 any hint to use either nickel or nickel containing two percent or less by weight of alloy metals. That is because the skilled person is aware that nickel is harmful to living tissue (see patent application, page 3, lines 10-11) and therefore would not be motivated to replace the bio-inert titanium-nickel alloy by pure or almost pure nickel.

Furthermore, the skilled person would not consider the disclosure of either D12 or D13, which relates to arrangements to be used in the formation of vacuum tubes/triodes, neither of which is adapted to or includes any suggestion for component assemblies for implant use. Moreover, the fact that pressure is used in the manufacturing methods of these documents means that there would be scope for the melted nickel to be squeezed out from between the ceramic part and the metal part, thus rendering the resultant article wholly unsuitable for implantation in living tissue.

- 4.6 In view of the above, the claimed component assembly is not obvious and claim 1 involves an inventive step. For the same reason, independent claim 5 also involves an inventive step. The dependent claims involve an inventive step *mutatis mutandis*.

5. Consequently, the new main request is allowable.

6. Amended description

During the oral proceedings before the board the appellant submitted a description which had been adapted to the claims of the new main request. The board acknowledges that the adapted description fulfils the requirements of the EPC.

Order

For these reasons it is decided that:

1. The decision under appeal is set aside.
2. The case is remitted to the examining division with the order to grant a patent on the basis of the following documents:
 - Claims 1 to 17, filed as new main request during oral proceedings on 15 February 2017;
 - Description pages 1 to 8 as filed during oral proceedings on 15 February 2017;
 - Figure pages 1/2 and 2/2 as published.

The Registrar:

The Chairman:



M. Cañueto Carbajo

J. Jardón Álvarez

Decision electronically authenticated