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# Datasheet for the decision of 25 November 2016

**Case Number:** T 0172/12 - 3.2.08

**Application Number:** 04253781.1

**Publication Number:** 1491283

**IPC:** B23K35/30, B23P6/04

**Language of the proceedings:** EN

**Title of invention:**
Repair process and brazing paste

**Patent Proprietor:**
United Technologies Corporation

**Opponent:**
Siemens Aktiengesellschaft

**Headword:**

**Relevant legal provisions:**
EPC Art. 56

**Keyword:**
Inventive step - (yes)

**Decisions cited:**

**Catchword:**

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**Beschwerdekammern**
**Boards of Appeal**
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**Case Number: T 0172/12 - 3.2.08**

# D E C I S I O N
## of Technical Board of Appeal 3.2.08
## of 25 November 2016

| | |
|---|---|
| **Appellant:** (Opponent) | Siemens Aktiengesellschaft<br>Wittelsbacherplatz 2<br>80333 München (DE) |
| **Representative:** | Siemens AG<br>Postfach 22 16 34<br>80506 München (DE) |
| **Respondent:** (Patent Proprietor) | United Technologies Corporation<br>10 Farm Springs Road<br>Farmington, CT 06032 (US) |
| **Representative:** | Leckey, David Herbert<br>Dehns<br>St Bride's House<br>10 Salisbury Square<br>London EC4Y 8JD (GB) |
| **Decision under appeal:** | **Decision of the Opposition Division of the European Patent Office posted on 6 December 2011 rejecting the opposition filed against European patent No. 1491283 pursuant to Article 101(2) EPC.** |

**Composition of the Board:**

| | |
|---|---|
| **Chairman** | I. Beckedorf |
| **Members:** | M. Alvazzi Delfrate |
| | C. Herberhold |

## Summary of Facts and Submissions

I. By its decision posted on 6 December 2011 the opposition division rejected the opposition against European patent No. 1 491 283.

II. The appellant (opponent) lodged an appeal against that decision in the prescribed form and within the prescribed time limit.

III. Oral proceedings before the Board of Appeal were held on 25 November 2016, for the course of which and the parties' requests reference is made to the minutes.

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

The respondent (patent proprietor) requested that the appeal be dismissed (*i.e.* that the patent be maintained as granted) or, in the alternative, that in setting aside the decision under appeal the patent be maintained in amended form on the basis of the auxiliary request filed with letter of 12 October 2012.

V. Claims 1 and 8 of the main request read as follows:

"1. A process for repairing at least one crack in a metal workpiece comprising the steps of:

forming a braze paste containing a first nickel base alloy material containing boron and chromium and a second nickel base alloy material containing chromium and cobalt; applying said brazing paste to an area of said metal workpiece containing said at least one crack; subjecting said brazing paste and said workpiece

to a brazing cycle by heating said brazing paste and said workpiece; and

wherein said braze paste forming step comprises mixing a first nickel base alloy material consisting from 14 wt% to 16 wt% chromium, from 2.4 wt% to 3.0 wt% boron, up to 0.15 wt% total other elements, and the remainder nickel and inevitable impurities and

a second nickel base alloy material consisting of from 22 wt% to 23 wt% chromium, from 18.5 wt% to 19.5 wt% cobalt, from 3.5 to 4.0 wt% titanium, from 1.8 wt% to 2.2 wt% tungsten, from 1.7 wt% to 2.0 wt% aluminum, from 1.2 wt% to 1.5 wt% tantalum, from 0.8 wt% to 1.2 wt% niobium, from 0.13 wt% to 0.17 wt% carbon, up to 0.2 wt% manganese, up to 0.015 wt% phosphorous, up to 0.10 wt% copper, up to 0.25 wt% iron, up to 0.10 wt% silicon, up to 0.04 wt% zirconium, from 0.001 wt% to 0.008 wt% boron, up to 0.005 wt% sulfur, up to 0.005 wt % nitrogen, up to 0.003 wt% oxygen, up to 0.0005 wt% silver, up to 0.0005 wt% lead, up to 0.00005 wt% selenium, up to 0.00003 wt% bismuth, up to 0.00005 wt% tellurium, up to 0.00005 wt% thallium, and the balance nickel and inevitable impurities."

"8. A brazing paste for repairing cracks in a metal workpiece, said paste comprising a mixture of a first nickel base alloy material and a second nickel base alloy material, said first nickel base alloy material consisting from 14 wt% to 16 wt% chromium, from 2.4 wt% to 3.0 wt% boron, up to 0.15 wt% total other elements, and the remainder nickel and inevitable impurities and, said second nickel base alloy material consisting of from 22 wt% to 23 wt% chromium, from 18.5 wt% to 19.5 wt% cobalt, from 3.5 to 4.0 wt% titanium, from 1.8 wt% to 2.2 wt% tungsten, from 1.7 wt% to 2.0 wt% aluminium,

from 1.2 wt% to 1.5 wt% tantalum, from 0.8 wt% to 1.2 wt% niobium, from 0.13 wt% to 0.17 wt% carbon, up to 0.2 wt% manganese, up to 0.015 wt% phosphorous, up to 0.10 wt% copper, up to 0.25 wt% iron, up to 0.10 wt% silicon, up to 0.04 wt% zirconium, from 0.001 wt% to 0.008 wt% boron, up to 0.005 wt% sulfur, up to 0.005 wt % nitrogen, up to 0.003 wt% oxygen, up to 0.0005 wt% silver, up to 0.0005 wt% lead, up to 0.00005 wt% selenium, up to 0.00003 wt% bismuth, up to 0.00005 wt% tellurium, up to 0.00005 wt% thallium, and the balance nickel and inevitable impurities."

The auxiliary request is not relevant to the present decision.

VI. The following documents played a role for the present decision:

E1: Jahnke B. *et al.* "Microstructural Investigations of a Nickel-based repair coating processed by liquid phase diffusion sintering", Thin Solid Films, 110 (1983) pages 225-235;
E5: WO -A- 89/03264;
E13: George E.P. *et al.* "IN-939 Based superalloys with improved weldability", VTT Symposium 2001, pages 139-148;
E14: Nicrobraz technical data sheet, Wall Colmonoy Corp. 1980;
E15: Gambone M.L. *et al.* "Properties of RS5 and other superalloys cast using thermally controlled solidification", in Superalloys 2000 edited by TMS, 2000.

VII. The arguments of the appellant can be summarised as follows:

*Documents E13, E14 and E15*

E13 and E14 were filed together with the statement setting out the grounds of appeal. They related to IN-939 alloy and Nicrobraz 150, both of which were cited in E1. Hence, they merely reinforced the arguments already submitted in the opposition proceedings and were a reaction to the appealed decision. As to E15, it was merely evidence of the composition of alloy IN-939 and had been filed in reaction to a comment in the Board's communication. Thus, E13, E14 and E15 should all be part of the proceedings.

*Inventive step*

E1 disclosed a repair process of the claimed type. A mixture of Ni-base alloy powders was used, wherein the high-melting powder was for instance IN-939. As shown in E13 and E15, the IN-939 alloy covered a range of possible compositions comprising also specific compositions in accordance with the claimed second Ni-base alloy material. Nicrobraz 150, whose properties were illustrated in E14 and whose composition differed from the first powder of the claimed invention solely by the B content, could be used as a low-melting alloy. Hence, the sole difference of the claimed method in respect of E1 was the use of a low-melting powder with a lower B content. The problem solved by means of this distinguishing feature was the optimisation of the melting temperature. It was known from E5 that the B content influenced the melting temperature. Since E5 disclosed a B content of the low-melting powder in

accordance with present claim 1, it was obvious to arrive at the claimed invention starting from E1.

Moreover, it was also obvious to arrive at the claimed invention starting from E5. The claimed method differed from the method disclosed in E5 solely by the composition of the high-melting alloy. However, E13 and E15, which disclosed a IN-939 composition in accordance with the claimed invention, rendered it obvious to choose this type of alloy when a component made of an IN-939 alloy was to be repaired.

Therefore, the subject-matter of claim 1 did not involve an inventive step.

VIII. The arguments of the respondent can be summarised as follows:

*Documents E13, E14 and E15*

E13 and E14 could have been filed in the opposition proceedings and were not *prima facie* relevant. E15 was not relevant either, and there was no justification for the delay in its submission. Hence, documents E13, E14 and E15 should be disregarded.

*Inventive step*

There was no disclosure that the IN-939 powder used in E1 had a composition in accordance with the second powder of the claimed invention. Moreover, Ni-Cr-Fe-Si-B, which was the sole alloy used in combination with the IN-939 powder, had contents of B and Si different from the first powder of the claimed invention. Nicrobraz 150 did not have the claimed B content either.

The problem solved by the claimed invention was to provide a more effective repair process.

It was not obvious to take the B content of the low-melting alloy of E5 in isolation and use it in the low-melting powder of E1. For this reason alone, it was not obvious to arrive at the claimed invention starting from E1.

Starting from E5, the person skilled in the art had no reason to change the high-melting powder, which already provided good results. In particular, a teaching in this direction could not be found in E13 or E15, which did not even deal with brazing alloys. Thus it was also not obvious to arrive at the subject-matter of claim 1 starting from E5.

Thus, the subject-matter of claim 1 involved an inventive step.

## Reasons for the Decision

1. Documents E13, E14 and E15

E13 and E14 were filed at the earliest possible stage in appeal, together with the statement setting out the grounds of appeal. Moreover, they relate to the properties and composition of the IN-939 alloy (E13) and Nicrobraz 150 (E14), both of which are components of the brazing mixtures studied in E1, the closest prior art in the opposition proceedings. Indeed, E13

and E14 do not support a new line of argument, but relate to the inventive step attack starting from E1 and can be considered as a reaction to the findings in the appealed decision. Under these circumstances, the Board decided that E13 and E14 should be taken into account.

E15 was submitted at a later stage, with letter of 18 February 2016. However, this document does not represent a new teaching to be considered for the assessment of inventive step, but is merely submitted as evidence of the composition of alloy IN-939, which was considered as a possible difference in view of E1 in the Board's communication (point 3, last paragraph). Thus, the Board decided to admit it into the proceedings.

2. Inventive step

2.1 The invention

The present invention relates to a process for repairing cracks in metal workpieces, in particular turbine engine components, by use of a brazing paste comprising a mixture of powders. The mixture comprises a high-melting alloy powder ("second nickel base alloy material" in the wording of claim 1) and a low-melting powder ("first nickel base alloy material" in the wording of claim 1). In this type of process, the composition of the high-melting powder is normally chosen on the basis of the component to be repaired and influences the choice of the low-melting powder.

2.2 Inventive step starting from E1

2.2.1 E1, which relates to a repair process of the type above and discloses the use of a high-melting powder (IN-939) similar to the second Ni-base alloy material of the present invention, is considered to represent the closest prior art.

E1 deals with the repair of a cast Ni-based IN-738LC superalloy (page 226, lines 8 to 12, page 229, Point 3.2). It discloses a process for repairing at least one crack in a metal workpiece, comprising the steps of: forming a braze paste containing a first nickel-base alloy material containing boron and chromium and a second nickel-base alloy material containing chromium and cobalt; applying said brazing paste to an area of said metal workpiece containing said at least one crack; subjecting said brazing paste and said workpiece to a brazing cycle by heating said brazing paste and said workpiece; and wherein said braze paste forming step comprises mixing a first nickel-base alloy material and the remainder nickel and inevitable impurities and a second nickel-base alloy material (see Figure 1 and points 3.1 and 3.2). The mixtures investigated in E1 comprise IN-738LC, IN-939 or NIM-75 powder as a high-melting powder and Nicrobraz 150 or Ni-Cr-Fe-Si-B as a low-melting powder.

2.2.2 Table I of E1 does not give any indication of the Zr content and indicates "-" for the B content of the IN-939 alloy used in this document. Hence, this table does not disclose a composition with a second Ni-base alloy material exhibiting B and Zr contents in accordance with claim 1 (up to 0.04 wt% Zr and from 0.001 wt% to 0.008 wt% B).

The appellant referred in this respect to documents E13 and E15, showing a composition in accordance within (the IN-32 analytical composition of table 3 of E13) or slightly removed from the ranges of the claimed second Ni base alloy material (the IN-939 composition of table 1 of E15). However, E13 discloses for the IN-939 alloy a nominal composition whose contents of B (0.01%) and Zr (0.1%) are outside the claimed range for the second Ni-base alloy material (Tables 2 and 3). As a matter of fact, of the several modifications of the IN-939 alloy studied in E13, only one (the IN-32 analytical composition of table 3) falls within the composition of the second Ni-base alloy material of the present invention. In E15, the "typical chemical composition" of the IN-939 alloy falls outside (in view of the B content of 0.009%) the claimed composition.

Thus, even accepting the view of the appellant that the IN-939 alloy covers a range of possible compositions comprising also specific compositions in accordance with the claimed second Ni-base alloy material, the person skilled in the art had no clear indication that, among those possible compositions, only one and which of said specific compositions was to be used when carrying out the teaching of E1. Therefore, the subject-matter of claim 1 differs from E1 by the contents of B and Zr of the second Ni base alloy material.

2.2.3 Additionally, none of the two low-melting point materials disclosed in E1, namely Ni-Cr-Fe-Si-B (which is the only one for which a powder mixture with the IN-939 alloy is explicitly disclosed, see Table II and points 4.1, 4.2 and 4.4 on pages 229 to 234) and Nicrobraz 150, exhibit a composition in accordance with the first Ni-base alloy material of claim 1: Nicrobraz

150 has a higher B content (3.5%) and Ni-Cr-Fe-Si-B has higher contents in B (3.5%) and comprises Si in an amount of 4.5%. Thus, the claimed subject-matter also differs from E1 by the composition of the first Ni-base alloy material.

2.2.4 The appellant argued that it was obvious, in view of the teaching of E5, to solve the problem of optimising the melting temperature of the mixture by reducing the boron content of the low-melting alloy powder in the claimed range, thus arriving at the claimed invention. The Board is not convinced by this argument.

First, as explained above, the B content of the low-melting alloy powder is not the only distinguishing feature over E1, whose high-melting alloy powder has different Zr and B contents.

Moreover, E5 discloses that with the mixture of high-melting and low-melting powder disclosed therein good results are obtained for any suitable superalloy metal body (paragraph bridging pages 7 and 8 and claim 1). Hence, E5 teaches not to just reduce the B content of the low-melting alloy powder but rather to use the mixture of powders disclosed in this document, which comprises a high-melting alloy powder that, among others in view of its lower Cr and Co contents (claim 1 and example 1), is not in agreement with present claim 1.

Thus, it was not obvious to arrive at the subject-matter of claim 1 starting from E1.

2.3 Inventive step starting from E5

E5 is less relevant than E1. As explained above, E5 teaches a mixture of a specific high-melting and low-melting alloy, to be used for the repair of any suitable superalloy. Without the knowledge of the claimed invention, the person skilled in the art had no reason to consider that the low-melting alloy of E5, which has been specifically selected to act together with the high-melting alloy of this document (see claim 1), could be used in a brazing repair process together with the currently claimed high-melting alloy. In particular, a teaching in this direction is not provided by either E13 or E15, which studies various IN-939 based alloys, whose compositions are not necessarily in accordance with the second nickel-base alloy of claim 1, and does not deal with brazing but with welding. Thus, it was also not obvious to arrive at the subject-matter of claim 1 starting from E5.

2.4 Therefore, the subject-matter of claim 1 involves an inventive step. Since the composition of the braze paste of claim 8 corresponds to that of the paste used in the process of claim 1, this conclusion also applies to claim 8.

**Order**

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

The appeal is dismissed.

The Registrar: The Chairman:

C. Moser I. Beckedorf

Decision electronically authenticated