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# Datasheet for the decision of 17 May 2018

**Case Number:** T 0486/14 - 3.2.06

**Application Number:** 07252261.8

**Publication Number:** 1867835

**IPC:** F01D5/00, B23K9/235, B23K15/00

**Language of the proceedings:** EN

**Title of invention:**
Enhanced weldability for high strength cast and wrought nickel superalloys

**Patent Proprietor:**
United Technologies Corporation

**Opponent:**
Siemens Aktiengesellschaft

**Headword:**

**Relevant legal provisions:**
EPC Art. 56, 84
RPBA Art. 13(1)

**Keyword:**
Inventive step - main request (no) - effect not made credible within the whole scope of claim
Late-filed auxiliary requests - prima facie unclear - request clearly allowable (no)

**Decisions cited:**

**Catchword:**

Europäisches Patentamt
European Patent Office
Office européen des brevets

**Beschwerdekammern**

**Boards of Appeal**

**Chambres de recours**

Boards of Appeal of the
European Patent Office
Richard-Reitzner-Allee 8
85540 Haar
GERMANY
Tel. +49 (0)89 2399-0
Fax +49 (0)89 2399-4465

**Case Number: T 0486/14 - 3.2.06**

# D E C I S I O N
# of Technical Board of Appeal 3.2.06
# of 17 May 2018

| | |
|---|---|
| **Appellant:** (Opponent) | Siemens Aktiengesellschaft<br>Werner-von-Siemens-Straße 1<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:** | **Interlocutory decision of the Opposition Division of the European Patent Office posted on 12 February 2014 concerning maintenance of the European Patent No. 1867835 in amended form.** |

**Composition of the Board:**

| | |
|---|---|
| **Chairman** | M. Harrison |
| **Members:** | P. Cipriano |
| | W. Ungler |

## Summary of Facts and Submissions

I. An appeal was filed by the appellant (opponent) against the interlocutory decision of the opposition division in which it found that European patent No. 1 867 835 in an amended form met the requirements of the EPC. The following documents, referred to by the appellant in its grounds of appeal, are relevant to the present decision:

D4 EP 0 969 114 B1

D7 M.D. Rowe, "Ranking the resistance of wrought superalloys to strain-age cracking", Supplement to the Welding Journal, February 2006, pages 27-34

D8 Kayacan, R. et al.,"The effects of pre- and post-weld heat treatment variables on the strain-age cracking in welded Rene 41 components", Materials Research Bulletin, Pergammon Press, New York, Vol. 39, (2004, 2171-2186), Elsevier 2004

II. The appellant requested that the interlocutory decision be set aside and the patent be revoked.

III. The respondent (patent proprietor) requested that the appeal be dismissed.

IV. The Board issued a summons to oral proceedings followed by a communication containing its provisional opinion, in which it indicated *inter alia* that the technical effect and the objective technical problem solved in the light of the differentiating features from the respective prior art starting points might need to be discussed, as also the question of why the skilled person would combine the teaching of D4 with D8 or

vice-versa to arrive at the claimed subject-matter without using inventive skill.

V. With letter of 8 February 2018 the appellant provided further arguments regarding its inventive step objection.

VI. Oral proceedings were held before the Board on 17 May 2018, during which the respondent filed an auxiliary request and a copy of a Wikipedia article relating to WASPALOY dated 17 May 2018, hereafter referred to as D16. The final requests of the parties were as follows:

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

The respondent requested that the appeal be dismissed (main request), auxiliarily that the patent be maintained in amended form on the basis of the auxiliary request filed during the oral proceedings of 17 May 2018.

VII. Claim 1 of the main request reads as follows:
"1. A method for repairing a turbine engine component comprising the steps of:

providing a turbine engine component formed from a nickel-based superalloy;
removing any defects from said turbine engine component;
said removing step comprising subjecting said turbine engine component to a solutioning heat treatment using a heating rate in the range of from 16.1°C (29 degrees Fahrenheit) per minute to approximately 22.2°C (40 degrees Fahrenheit) per minute as the component passes

through a temperature in the range of from (593°C) (1100 degrees Fahrenheit) to 871°C (1600 degrees Fahrenheit); and
cooling said turbine engine component from a maximum heat solution heat treatment temperature to a temperature below 677°C (1250 degrees Fahrenheit) at a cooling rate of from 0.28°C to 0.56°C (0.5 to 1.0 degrees Fahrenheit)/minute;
welding said turbine engine component to effect said repair."

Claim 1 of the auxiliary request differs from claim 1 of the main request in that the feature concerning the material of the turbine engine component reads as follows:
"providing a turbine engine component formed from a nickel-based superalloy wherein the nickel-based superalloy is Waspaloy;"

VIII. The appellant's arguments may be summarised as follows:

*Main request- inventive step*

D4 was a starting point for an inventive step attack on the subject-matter of claim 1. It disclosed in paragraph 16 an embodiment comprising all the features of claim 1 with the exception of a heating rate "in the range of from 16.1°C (29 degrees Fahrenheit) per minute to approximately 22.2°C (40 degrees Fahrenheit) per minute". In D4 the disclosed heating rate was 27.7°C/ minute (50 degrees Fahrenheit/minute). The resulting objective problem to be solved was then to find an alternative heating rate.

There was no effect associated with the upper limit of the claimed range. In fact, the patent disclosed in

paragraph 19 that the heating rate should be such that the component should be in the precipitation range from 593°C to 871°C for as little time as possible, never more than 17 minutes and preferably less than 13 minutes.
The choice of 22.2°C as the upper limit for the range was thus completely arbitrary and any other known suitable value could have been used.

In addition, even if it were considered that there was an effect associated with the upper limit of the heating rate, the patent only showed photomicrograph results for WASPALOY samples and it could not be inferred that the effect occurred in all the nickel-based superalloys over the entire breadth of the claim.

The skilled person would consider D8, which disclosed such a value, since the preferred pre-weld heating solution treatments disclosed therein used a heating rate of 20°C per minute.

*Auxiliary Request - admittance*

The term WASPALOY was a registered trademark and did not correspond to a specific chemical composition of an alloy. The chemical composition marketed under the term WASPALOY might change with time, consequently changing the scope of the claim. D7, for example, disclosed a WASPALOY comprising Niobium which is not referred to in D16 as an element of WASPALOY. Such an amendment thus introduced a lack of clarity into claim 1. The request should therefore not be admitted since claim 1 was *prima facie* unclear.

IX. The respondent's arguments may be summarized as follows:

*Main request- inventive step*

The heating and cooling rates together had the combined effect of controlling the micro-cracking at the grain boundary.

The objective technical problem to be solved by the heating rate could not be dissociated from the cooling rate and it was thus to increase high temperature ductility and improve weldability.

Paragraphs 21 and 31 made it clear that "Waspaloy" was only shown as an example in the patent and that the method and its effects applied over the whole claimed range.

The skilled person would consider D8 but would not see a technical effect in isolating the heating rate from the cooling rate in the treatment of D8. The skilled person would not only change the heating rate but also adapt the cooling rate of D4 and increase it from 0.56°C (1 degree Fahrenheit) to the cooling rate of 34°C of Sample Group 6 of D8, which was considered the Sample Group with the best results and thus not arrive at the subject-matter of claim 1.

*Auxiliary Request - admittance*

The term "Waspaloy" corresponded to a well defined and known range of alloys for the skilled person and did not introduce a lack of clarity into claim 1.

## Reasons for the Decision

1. Main request - inventive step

1.1 It was not contested by the parties that starting from D4 as the most promising starting point for considering inventive step, the subject-matter of claim 1 differs herefrom by the feature

"a heating rate in the range of from 16.1°C (29 degrees Fahrenheit) per minute to approximately 22.2°C (40 degrees Fahrenheit) per minute"

The Board also finds no reason to disagree with this. D4 discloses in paragraph [0016] a pre-weld heat treatment for the alloy IN939 with a heating rate of 27.8°C ("50 degrees Fahrenheit") per minute, i.e. above the claimed range.

1.2 Paragraphs [0018] and [0019] of the patent explain that during exposure to the intermediate temperature range of from 593°C to 891°C, additional grains are created through solid state precipitation and that this precipitation changes the crystallography thus causing aging strains, possibly leading to strain age cracking prior to welding as the component is heated and cooled (see patent on column 4, lines 45-46 and column 5, lines 13 and 16-19). The turbine engine component to be repaired should therefore stay for as short a time as possible within this precipitation temperature range in order to minimize the occurrence of strain age cracking prior to welding. Paragraph [0019] then states that the

component should not be within this range "for more than 17 minutes, preferably less than 13 minutes", which would lead to heating rates of more than 17.5°C and preferably more 22.9°C per minute, respectively. Paragraph [0019] does not disclose any reason or effect as to why the heating range should have an upper limit, instead teaching the skilled person that the heating rate should be as high as possible and preferably even higher than the claimed upper limit of the heating rate. The skilled person thus does not recognize in this paragraph, or from any other passage in the whole content of the patent, any effect of setting an upper limitation at 22.2°C per minute. Based therefore on the patent itself, this upper limit is not disclosed as anything but an arbitrary value that does not lead to any technical effect.

1.3 The respondent's argument that the objective technical problem was to increase high temperature ductility and weldability is not accepted by the Board. As explained in paragraph [0020] of the patent and in D8 in the passage bridging pages 2179 and 2180, it is the slow cooling rate and not the fast heating rate that allows more time for the γ' precipitation to occur and for the γ' particles to grow resulting in an increased high temperature ductility. This will ultimately reduce the likelihood of cracking during welding (as evident from the patent on column 5, lines 24-25 and column 6, lines 2-4, as well as D8, page 2180, last line) which is a different effect than the one provided by a fast heating rate.

Paragraph [0021] of the patent also explains that the increase in the number and size of γ' particles shown in Figures 1B and 2B in relation to Figures 1A and 2A, respectively, is a consequence of slow cooling rates.

Even if the changes in the γ' particles (consequently increasing high temperature ductility) could be attributed to the heat treatment as a whole and to the heating rate range, as the respondent argued, all the detailed embodiments and photomicrographic inspection results of the patent relate to WASPALOY, and there is no information on file to make it credible that such an upper limitation in the heating rate would also lead to an increase in high temperature ductility for other nickel-based superalloys (i.e. over the whole breadth of the claim). Paragraph [0031] states only generally that the invention could be used with other alloys and does not provide any concrete information that could support the respondent's allegation that the effect is also present in other alloys. Also D4, paragraph [0014], confirms that some degree of adaptation is required for the invention to work with other nickel base superalloys.

1.4 Thus, whilst it is true that both the heating rate and the cooling rate have ultimately an effect on weldability, the rates provide different effects that lead to different objective technical problems - the heating rate affects cracking before welding whilst the cooling rate will affect cracking during welding. Moreover, as discussed above, the claimed upper limit to the heating rate is an arbitrary value which has not been demonstrated to provide any effect over the prior art. In this case, the Board does not find that it is appropriate to generalize the formulation to a common technical problem (such as "to improve weldability") to encompass the effects of features that are already known from the prior art. The drafting of the technical problem should be derived only from the effect provided by the differing feature over the whole scope of the claim.

1.5 As explained under item 1.2, in the present case there is no effect in setting an upper limit to the heating rate, since any heating rate that would minimize the time within the precipitation range would work. Thus, the upper limitation must be regarded as arbitrary, and the formulation of the technical problem can thus only be seen as being to provide an alternative heating rate suitable to minimize strain age cracking before welding.

1.6 The skilled person faced with this technical problem would look into D8, since D8 also deals with the improvement of the heat treatments of alloys. Table 3 discloses several pre-weld treatments applied to nine different sample groups. In these nine different samples only two different heating rates have been used: 10°C per minute for sample 7 and 20°C per minute for all the others.

D8, page 2182, 1st paragraph, discloses the results of sample group 7, where cracks were observed, and gives rise to the possibility that such cracks might be due to "the longer exposures of the samples in the temperature range of precipitation". Since for the preferred sample group 6, where only the heating rate was increased, these cracks were not present and in the remaining sample groups other parameter changes explained the cracks, the skilled person would learn from D8 that a heating rate of 20°C per minute is perfectly suitable to provide a short enough exposure to the precipitation temperature range and avoid strain age cracking before the welding operation for the alloy Rene 41.

However, since D4 already teaches in paragraph [0014] that, generally, the teaching of D4 can be used also with other nickel-based alloys such as Rene 41, the skilled person recognizes (when looking for alternative heating rates to adapt the method of D4 from paragraph [0016] as suggested in the paragraph itself) that methods for Rene 41 would also come into question. The skilled person would thus recognize that the value of 20°C per minute used in D8 is perfectly suitable to be used in the method described in paragraph [0016] for IN 939 in D4.

1.7 When adapting the method of D4, and being faced with D8, the skilled person would not necessarily increase also the cooling rate, despite the fact that D8 discloses that slow cooling rates lead to a decrease in the hardness of the alloy, as the respondent argued. D8, sentence bridging pages 2179 and 2180, discloses on the other hand that slow cooling rates provide an advantageous increase in ductility and thus it is up to the skilled person reading the document to choose which effect they would like to obtain.

As discussed above, the heating rate and the cooling rate provide different effects, so that when changing the heating rate, the skilled person does not need, necessarily, to also change the cooling rate, as this provides a different effect.

In addition, the method disclosed in paragraph 16 of D4, used as a starting point, and having a specific cooling rate already foresees that "other heating rates can be used in the practice of the invention". The skilled person is then aware that a change of the heating rate in the method in D4 can be carried out without changing the cooling rate as well.

Further, D4 (see for example in paragraphs [0004] and [0015] or claim 1) generally teaches that cooling rates below 3°F per minute and preferentially of 1°F per minute or less provide gamma prime precipitation in the gamma matrix improving weldability, so the skilled person looking for a suitable heating rate would not ignore the clear teaching of D4 and contemplate changing also the cooling rate.

Further, the reduction of hardness associated in D8 with slow cooling rates would not prompt the skilled person to change the cooling rate of D4, since this drawback is not related to the objective problem that the skilled person is trying to solve.

The same reasoning applies to the precipitation of $M_{23}C_6$ carbides as thin films at the grain boundaries, which is responsible for grain boundary embrittlement (as disclosed on page 2172, lines 18-20). This embrittlement results in a loss of ductility and could be responsible for (micro-)cracking at the grain boundary, but in operations after the heat treatment, which is not related to the objective problem that the skilled person is trying to solve.

1.8 For the above reasons, the subject-matter of claim 1 of the main request does not involve an inventive step (Article 56 EPC) when starting from D4 and, given the problem to be solved, considering the teaching of D8.

2. Auxiliary request - admittance

2.1 Claim 1 of the auxiliary request differs from claim 1 of the main request in that the nickel-based superalloy is defined as being "Waspaloy".

2.2 The request was filed during the oral proceedings, hence at the latest possible stage in the proceedings, and the Board needed to exercise its discretion as to whether the request should have been admitted into proceedings in accordance with Article 13(1) RPBA. In order to be admitted, *inter alia* the aspect of procedural economy given in Article 13(1) RPBA should be considered, which implies at least that the request should be *prima facie* allowable in the sense that it overcomes the objections raised without giving rise to new objections. This is however not the case for claim 1 of this request, for the following reasons.

2.3 As confirmed in D16, the Wikipedia article relating to WASPALOY filed by the respondent during the oral proceedings, WASPALOY is a registered trademark that refers to a nickel-based superalloy. The reliance on a trademark in claim 1 introduces a lack of clarity, since it cannot be guaranteed that the alloy referred to with the trademark WASPALOY has a single, established composition, nor that such composition stays constant over time.

2.4 The respondent argued that WASPALOY corresponded to a well defined known range of alloy compositions belonging to common general knowledge as demonstrated by D16 and disclosed a chemistry table with the minimum and maximum wt% values that each non-residual component of the alloy could have. The Board cannot accept this argument however, since, as shown e.g. in table 1 of D7, the chemical composition analysis of two WASPALOY samples in 2006 contained 0.05 and 0.07 wt% values of Niobium (Nb), respectively. The chemistry table of D16 does not even comprise Niobium, which is thus not part of the composition of WASPALOY in May 2018.

2.5 Contrary to the respondent's argument, the wt% values of Niobium cannot be considered as residual values such that the WASPALOY samples analysed in D7 also fall within the composition shown in D16. In this regard. the chemistry table of D16 discloses even smaller wt% values of other elements, such as Zirconium (Zr), Boron (B), Phosphorus (P) and Sulphur (S). If alloys carrying the designation WASPALOY in 2018 would still contain Nb, it would be expected that the latter element would necessarily appear in the elements listed in the chemistry table of D16. The trademark WASPALOY thus does not have such a well known meaning that would imply a constant and defined chemical composition belonging to common general knowledge of the skilled person. The introduction of the trademark WASPALOY in claim 1 thus renders the claim *prima facie* unclear.

2.6 As claim 1 of the auxiliary request *prima facie* does not meet the requirement of Article 84 EPC and is thus at least *prima facie* not allowable, the Board exercised its discretion not to admit this request into the proceedings (Article 13(1) RPBA).

**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:

M. H. A. Patin M. Harrison

Decision electronically authenticated