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Datasheet for the decision of 3 August 2016

Case Number: T 2209/14 - 3.2.08

Application Number: 05011190.5

Publication Number: 1605074

IPC: C22F1/10

Language of the proceedings: EN

Title of invention:
Thermal recovery treatment for a service-degraded component of a gas turbine

Patent Proprietor:
Kabushiki Kaisha Toshiba

Opponent:
Siemens Aktiengesellschaft

Headword:

Relevant legal provisions:
EPC Art. 100(c), 100(a), 54, 56
RPBA Art. 12(4), 13(1), 13(3)

Keyword:
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Novelty
Inventive step

Decisions cited:

Catchword:

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Case Number: T 2209/14 - 3.2.08

D E C I S I O N
of Technical Board of Appeal 3.2.08
of 3 August 2016

Appellant: (Opponent)	Siemens Aktiengesellschaft Wittelsbacherplatz 2 80333 München (DE)
Representative:	Siemens AG Postfach 22 16 34 80506 München (DE)
Respondent: (Patent Proprietor)	Kabushiki Kaisha Toshiba 1-1, Shibaura 1-chome, Minato-ku Tokyo 105-8001 (JP)
Representative:	Hoffmann Eitle Patent- und Rechtsanwälte PartmbB Arabellastraße 30 81925 München (DE)
Decision under appeal:	**Decision of the Opposition Division of the European Patent Office posted on 10 November 2014 rejecting the opposition filed against European patent No. 1605074 pursuant to Article 101(2) EPC.**

Composition of the Board:

Chairman	I. Beckedorf
Members:	M. Alvazzi Delfrate
	M. Foulger

Summary of Facts and Submissions

I. By decision posted on 10 November 2014 the opposition division rejected the opposition against the European patent no. 1605074.

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

III. Oral proceedings before the Board of Appeal were held on 3 August 2016. For the course of the oral proceedings 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 or, in the alternative, that in setting aside the decision under appeal the patent be maintained in amended form on the basis of one of the sets of claims filed as auxiliary requests I to VIII with letter of 13 July 2015 or according to an auxiliary request VIIIa indicated on page 9 of said letter.

V. Claim 1 of the **main request** reads as follows:

"A method for refurbishing a service-degraded component formed of a precipitation strengthening type of alloy for a gas turbine, comprising:

performing a recovery heat treatment on the component in an environment having a predetermined pressure that is greater than atmospheric pressure and can prevent the component from incipient melting;

wherein the temperature of the component is increased to a predetermined temperature in the environment having the predetermined pressure, the predetermined temperature being more than at least one of a solid solution temperature of γ' phases in the alloy or the incipient melting temperature of the component;

performing a solution heat treatment, which is processed under reduced pressure or inert gas atmosphere, the solution heat treatment being performed after performing the recovery heat treatment; and

performing an aging heat treatment, which is processed under reduced pressure or an inert gas atmosphere, the aging heat treatment being performed after performing the recovery heat treatment."

Claim 1 of **auxiliary request I** reads as follows (emphasis added):

"A method for refurbishing a service-degraded component formed of a precipitation strengthening type of alloy for a gas turbine, comprising:

performing a recovery heat treatment on the component in an environment having a predetermined pressure that is greater than atmospheric pressure and can prevent the component from incipient melting;
wherein the step of performing the recovery heat treatment includes increasing pressure of the component to the predetermined pressure and retaining the pressure at the predetermined pressure

wherein the temperature of the component is increased to a predetermined temperature in the environment having the predetermined pressure, wherein the

temperature of the component is increased to the predetermined temperature after the pressure has reached the predetermined pressure, the predetermined temperature being more than at least one of a solid solution temperature of γ' phases in the alloy or the incipient melting temperature of the component;

performing a solution heat treatment, which is processed under reduced pressure or inert gas atmosphere, the solution heat treatment being performed after performing the recovery heat treatment; and

performing an aging heat treatment, which is processed under reduced pressure or an inert gas atmosphere, the aging heat treatment being performed after performing the recovery heat treatment."

Claim 1 of **auxiliary request II** reads as follows (emphasis added):

"A method for refurbishing a service-degraded component formed of a precipitation strengthening type of alloy for a gas turbine, comprising:

performing a recovery heat treatment on the component in an environment having a predetermined pressure that is greater than atmospheric pressure and can prevent the component from incipient melting;
wherein the temperature of the component is increased to a predetermined temperature in the environment having the predetermined pressure, the predetermined temperature being more than at least one of a solid solution temperature of γ' phases in the alloy or the incipient melting temperature of the component;

performing a solution heat treatment, which is processed under reduced pressure or inert gas atmosphere, the solution heat treatment being performed after performing the recovery heat treatment; and

performing an aging heat treatment, which is processed under reduced pressure or an inert gas atmosphere, the aging heat treatment being performed after performing the recovery heat treatment, and
wherein the step of performing recovery heat treatment further comprises, after starting the recovery heat treatment, decreasing the temperature of the component from the predetermined temperature before starting decreasing the pressure from the predetermined pressure."

Auxiliary requests III to VIII and VIIIa are not relevant for the present decision.

VI. The following documents are cited in the present decision:

D2: J. of Materials Science, "Rejuvenation procedures to recover creep properties of nickel-base superalloys by heat treatment and hot-isostatic pressing techniques", Baldan A., 1991, Nr. 26, 3409-3421;
D4: US -A- 4,302,256;
D6: GB -A- 2 098 119;
D11: GB -A- 1 510 824;
D12: US -A- 5,573,609

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

Late-filed documents D11 and D12

Both D11 and D12 had been cited at the earliest possible stage in appeal proceedings, namely with the statement of grounds of appeal. D12 was used to substantiate an attack of lack of inventive step, while D11 was used to substantiate that the pressure influenced the incipient melting temperature. Therefore, both documents were relevant and should be admitted into the proceedings.

Main request - Article 100(c) EPC

Claim 1 as granted comprised the feature that the predetermined pressure can prevent the component from incipient melting. This feature was added from claim 3 as originally filed, which, however, defined further features that were not comprised in present claim 1. Original claim 3 excluded the embodiment of Figure 2 because it required that the pressure was retained at the predetermined pressure and that the increase in temperature only started when the predetermined pressure was attained. The omission of these features represented an inadmissible intermediate generalisation.

Main request - Novelty

D4 disclosed a method that could be used for refurbishing a service-degraded component formed of a precipitation strengthening type of alloy for a gas turbine. The treatment pressure was attained before the treatment temperature. This was made clear by the passage on column 6, lines 56 to 62, according to which the furnace was heated up to the treatment temperature

"after the chamber is charged with an inert gas". Therefore, D4 disclosed a method with all the features of claim 1, whose subject-matter thus lacked novelty.

Analogous considerations applied in respect of D6, whose disclosure was similar to that of D4.

Main request - inventive step

D2 could be considered the closest prior art for the assessment of inventive step. The claimed method was distinguished over the method of D2 solely by the order in which the predetermined temperature and the predetermined pressure were attained. The claimed order had no technical effect and was a mere alternative. It was obvious to choose the claimed alternative to raise first the temperature and thus the pressure, especially because D2 itself stressed the importance of avoiding incipient melting and the person skilled in the art was well aware of the influence of pressure on the melting temperature. Therefore, the subject-matter of claim 1 did not involve an inventive step starting from D2.

Furthermore, the subject-matter of claim 1 lacked an inventive step also starting from D4. This line of attack should also be taken into consideration, despite the fact that it had been submitted late, because of its high relevance.

Auxiliary request I

Auxiliary request I did not add any further distinguishing features in view of D2 and thus lacked an inventive step for the same reasons as the main request.

Auxiliary request II - inventive step

The wording added to claim 1 of auxiliary request II merely excluded the operation of pressure-releasing means before that of cooling means. Moreover, the end temperature of the pressure-maintaining phase was not defined. Hence, the chosen cooling was merely an obvious alternative for carrying out the method of D2.

In any event, D4 taught the claimed solution, because it disclosed heat treating the alloy part after HIP in situ by rapidly cooling it below the age-hardening temperature while maintaining it under superatmospheric pressure.

Therefore, the method of claim 1 of auxiliary request II did not involve an inventive step.

Adaptation of the description

The description was not sufficiently adapted to auxiliary request II.

Paragraph [0019] related to an advantage of the invention and should thus be adapted to the more limited scope of auxiliary request II.

The heat treatment process S102 referred to in paragraphs [0040] and [0059] was not necessarily in agreement with claim 1. Hence, the method comprising step S102 should not be referred to as an "embodiment".

Figure 2 showed a recovery heat treatment cycle whose heating part was not in accordance with claim 1, thus

leading to a discrepancy between the description and the claims.

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

Late-filed documents D11 and D12

Both D11 and D12 were late-filed. Moreover, neither of them were relevant and no objection was based on D12. Hence, they should be disregarded.

Main request - Article 100(c) EPC

The feature that the predetermined pressure could prevent the component from incipient melting could be found for instance in claim 3 as originally filed. No feature from original claim 3 was omitted. The wording "increased to a predetermined temperature" was always to be interpreted in the same way and did not say anything about the pressure at the start of the temperature increase. A maintenance of the pressure at the predetermined pressure was also foreseen by present claim 1. The embodiment of Figure 2 was covered both by present claim 1 and by original claim 3. Indeed this embodiment could also be seen as a basis for the amendment of claim 1. Therefore, no added subject-matter which extended beyond that of the application as filed was present in claim 1.

Main request - Novelty

D4 did not disclose that the treatment pressure was attained before the treatment temperature. In particular neither the prior art discussion nor the passage on column 6, lines 56 to 62 disclosed this

feature. The wording "charged with an inert gas" did not mean that the final treatment pressure was already achieved prior to heating to the treatment temperature. Rather the treatment pressure was achieved at a later stage by pumping an thermal expansion. At least for this reason the subject-matter of claim 1 was novel over D4.

Analogous considerations applied to D6, and hence the subject-matter of claim 1 was also new with respect to this document.

Main request - inventive step

Starting from D2 the claimed method was distinguished by the feature that the temperature of the component was increased to the predetermined temperature in the environment having the predetermined pressure.

As shown by examples 15 and 16 of Figure 3 of the patent, the distinguishing feature improved both the creep rupture life and its deviation. The prior art did not render it obvious to achieve this effect in accordance with the claim. Therefore, the subject-matter of claim 1 involved an inventive step starting from D2.

The line of attack starting from D4 was submitted at a very late stage without any reason and was even less relevant. Therefore, it should be disregarded.

Auxiliary request I

Auxiliary request I was amended to address the objections raised in respect of added subject-matter

but did not add to inventive step in comparison to the main request.

Auxiliary request II - inventive step

The wording added by auxiliary request II limited the claimed method to processes where first the temperature started to be decreased and only afterwards the decrease of the pressure was started. This cooling required an active pumping of gas into the furnace and was not disclosed in D2.

The effect on the avoidance of incipient melting was beneficial and the claimed cooling was not rendered obvious by D2.

D4 did not teach said cooling either because it merely disclosed keeping a "superatmospheric pressure" and not the treatment pressure during the cooling.

Hence, the method of claim 1 involved an inventive step.

Adaptation of the description

The description, with amended pages 3 and 4, was correctly adapted to the claims of auxiliary request II.

The advantage described in paragraph [0019] applied also to auxiliary request II.

The heat treatment process S102, referred to in paragraphs [0040] and [0059], exhibited a cooling phase in accordance with claim 1.

The alleged discrepancy between the description referring to Figure 2 and claim 1 was already present in the patent as granted, so that this objection was not admissible.

Reasons for the Decision

1. Late-filed documents D11 and D12

Both D11 and D12 have been cited for the first time with the statement setting out the grounds of appeal. Hence, it is within the discretionary power of the Board to admit them or not into the proceedings (Article 12(4) RPBA).

It is true that both these document have been cited at the earliest possible stage in appeal proceedings. However, only D12 has been used to substantiate an attack to the patentability of the claimed invention (lack of inventive step, see page 8 of statement of grounds of appeal), while D11 is used merely to substantiate the undisputed fact that the pressure influences the incipient melting temperature (see paragraph bridging pages 5 and 6 of statement of grounds of appeal). Accordingly, D11 is not seen as relevant.

Under these circumstances, the Board decided to admit D12 and not to admit D11 into the proceedings.

2. Main request - Article 100(c) EPC

2.1 Claim 1 as granted stipulates that the predetermined pressure can prevent the component from incipient melting. This feature, which was added into claim 1 during the examination procedure, is disclosed in claim 3 as originally filed.

2.2 The appellant did not dispute this but argued that original claim 3 defined further features that were not comprised in present claim 1, namely that the pressure was retained at the predetermined pressure and that the increase in temperature only started when the predetermined pressure is attained. However, this argument is not persuasive.

2.2.1 The Board is, like the appellant, of the opinion that the wording of present claim 1 does not require that the increase in temperature only starts when the predetermined pressure is attained but merely that the increase in temperature is finished ("increased to a predetermined temperature") after the predetermined pressure is attained. Indeed, the pressure at the start of the temperature increase is not stipulated by the claim. Hence, the claim encompasses the embodiment of Figure 2, which shows a cycle where the temperature increase is started before attaining the predetermined pressure.

However, claim 3 as originally filed does not stipulate the pressure at the start of the temperature increase either. Rather, it stipulates "increasing the temperature of the component to the predetermined temperature after the pressure has reached the predetermined pressure" (emphasis added), i.e. it merely requires that the increase in temperature is finished after the predetermined pressure is attained,

thus also covering the embodiment shown in Figure 2. Therefore, no omitted feature can be seen in this respect.

2.2.2 Moreover, even if, for the sake of argument, the interpretation of the appellant of original claim 3 as defining the pressure at the start of the temperature increase were to be followed, the same interpretation would also apply to present claim 1, so that also in this case no feature would have been omitted.

2.2.3 In respect of the expression "retaining the pressure at the predetermined pressure" (present in original claim 3) it is true that this wording is not comprised *expressis verbis* in claim 1 of the main request. However, present claim 1 stipulates that "the temperature of the component is increased to a predetermined temperature in the environment having the predetermined pressure", thus implicitly requiring that the predetermined pressure is retained for a certain time while the temperature is increased to the predetermined temperature. Hence, also in this respect no omitted feature can be seen.

2.3 In any event, even if it were to be considered that original claim 3 requires that the increase in temperature is started only after the predetermined pressure is attained, at least Figure 2 would make it clear to the person skilled in the art reading the application as originally filed that also embodiments where this is not the case were to be considered as part of the invention, thus providing a basis for the omission of this feature.

2.4 Therefore, the addition of the feature that the predetermined pressure can prevent the component from

incipient melting into claim 1 does not represent an unallowable intermediate generalisation. Accordingly, claim 1 does not comprise subject-matter which extends beyond the content of the application as originally filed.

3. Main request - Novelty

3.1 D4 relates to a method that can be used for refurbishing a service-degraded component formed of a precipitation strengthening type of alloy for a gas turbine (column 1, lines 5 to 14 and column 2, lines 57 to 62).

In the description of the prior art, D4 discloses a treatment of René 80 superalloy castings in an autoclave heated to 1218°C at a pressure of 10000 psig (6894 Pa), followed by solution treatment and aging (column 1, lines 40 to 57). However, this passage does not disclose that the treatment pressure is attained before the treatment temperature.

Nor is this disclosure to be found in the description of the invention of D4, in particular in the passage on column 6, lines 56 to 62. According to this passage in a particular cycle the furnace is heated up to the treatment temperature "after the chamber is charged with an inert gas". However, the wording "charged with an inert gas" does not necessarily mean that the final treatment pressure is already achieved at this stage prior to reaching the treatment temperature. On the contrary, the following sentence, according to which "pressures as high as about 30,000 psig or higher may be reached from the combined effects of pumping and thermal expansion" rather suggests that the furnace is merely filled with inert gas and that the treatment

pressure is achieved by pumping and thermal expansion during the heating.

Therefore, at least the feature that the temperature of the component is increased to the predetermined temperature in the environment having the predetermined pressure is not disclosed in D4 (neither in the acknowledgement of the prior art nor in the description of the invention).

Accordingly, the subject-matter of claim 1 is novel over this document.

3.2 Analogous considerations apply to D6, whose disclosure is similar to that of D4 (see in particular page 1, lines 23 to 32 and page 6, lines 8 to 13 of D6). Therefore, the subject-matter of claim 1 is also novel over D6.

4. Main request - inventive step

4.1 D2 relates to a method for refurbishing a service-degraded component formed of a precipitation strengthening type of alloy for a gas turbine (abstract). D2 discloses a method that comprises Hot Isostatic Pressing (HIPing), solution treatment and ageing (page 3415, point 5.2 and page 3417, points 5.2(ii) and 5.2(iii)). The fact that solution treating and ageing are performed under vacuum or inert atmosphere is implicit for the person skilled in the art. The HIPing step, i.e. the recovery heat treatment, is performed under conditions that avoid incipient melting (page 3417, point 5.2(i)). Therefore, D2 discloses performing a recovery heat treatment (the HIP step) on the component in an environment having a predetermined pressure that is greater than atmospheric

pressure and can prevent the component from incipient melting, the predetermined temperature being more than at least one of a solid solution temperature of γ' phases in the alloy or the incipient melting temperature of the component (page 3417, point 5.2(i)). Since it describes a method with a number of features in common with claim 1 and explicitly discloses the necessity to avoid incipient melting D2 is considered as the closest prior art.

D2 does not describe in which order the predetermined temperature and the predetermined pressure are attained. Hence, it does not disclose that the temperature of the component is increased to a predetermined temperature in the environment having the predetermined pressure.

The respondent argued, referring to examples 15 and 16 of Figure 3, that the distinguishing feature improved both the creep rupture life and its deviation. However, example 15 is not in accordance with the method disclosed in D2, because it relates to a HIP cycle wherein the temperature is first increased to 1205°C and then the pressure is increased to 100 MPa, so that no measure is taken to prevent incipient melting and resolidification during the heat recovery treatment (see paragraphs [0058] and [0064]). Accordingly, Figure 3 does not provide evidence of an effect of the distinguishing feature.

On the contrary, no effect can be associated with the distinguishing feature, because it does not define starting from which temperature the pressure to which the component is subject is the predetermined pressure.

Therefore, the problem solved by the claimed invention is merely to select the conditions for putting into practice the process of D2.

In the process of D2 there is a limited number of possibilities for the order in which the predetermined pressure and the predetermined temperature are achieved. Essentially either the pressure is attained before the temperature or *vice versa*. The possibility of achieving them exactly at the same time requires a perfect process control and would be excluded by the person skilled in the art unless some specific requirement in this sense exists, which is not the case for D2. The two possibilities above are equivalent for the person skilled in the art, because they can be both put into practice by the combination of pumping and thermal expansion normally used for increasing the pressure during the heating phase in HIP. Hence, they both represent obvious solutions of the problem above.

Therefore, the claimed choice of one of said obvious solutions does not involve an inventive step starting from the closest prior art D2.

4.2 The line of attack starting from D4 is less relevant, because this prior art, which does not explicitly teach avoiding incipient melting, is a less promising starting point than D2. Moreover, the appellant did not provide any justification for the delay in the submission of this line of attack, which was presented for the first time at the oral proceedings before the Board. Under these circumstances the Board decided to exercise its discretion under Article 13(1) and (3) RPBA by disregarding this line of attack.

5. Auxiliary request I

As admitted by the respondent, auxiliary request I does not purport to change the situation in respect of inventive step but is merely intended to address the objections raised in respect of added subject-matter. Therefore, the subject-matter of its claim 1 does not involve an inventive step for the same reasons given for the main request.

6. Auxiliary request II - inventive step

The wording added to claim 1 of auxiliary request II specifies "decreasing the temperature of the component from the predetermined temperature before starting decreasing the pressure from the predetermined pressure". This wording defines the actual cycle of temperature and pressure in the cooling of the recovery heat treatment. Hence, contrary to the appellant's opinion, it does not merely exclude the operation of pressure-releasing means before that of cooling means but rather limits the claimed method to processes where first the temperature starts to be decreased and only afterwards the decrease of the pressure is started. In order to realise this cooling some gas needs to be actively pumped into the furnace during the temperature cooling because otherwise the temperature reduction would automatically result in a decrease of the pressure. Hence, auxiliary request II introduces a further distinguishing feature in respect of D2, which does not give any detail in respect of the cooling cycle during the recovery heat treatment.

The claimed cooling, even if the pressure is not maintained at the predetermined pressure until the temperature reaches the incipient melting temperature

at ambient pressure, provides a greater safety margin in the recovery heat treatment because it renders it easier to control the pressure at a level that avoids incipient melting during cooling.

Due to the need to actively pump gas into the furnace, the claimed cooling is not an equivalent alternative to starting the temperature decrease and the pressure decrease at the same time. Hence, it would not be obvious for the person skilled in the art to choose the claimed solution unless he was specifically taught in this direction.

D2 itself does not provide any teaching as to how the cooling of the recovery heat treatment is to be performed. Hence, it does not hint at the claimed solution.

It is true that claim 1 of D4 teaches heat treating the alloy part after HIP in situ by rapidly cooling it below the age-hardening temperature while maintaining it under "superatmospheric pressure". However, "superatmospheric pressure" is merely a pressure above the atmospheric pressure and not the predetermined pressure at which HIP treatment takes place. Hence, contrary to the appellant's opinion D4 also does not teach in direction of the claimed method.

Therefore, the prior art does not render it obvious to arrive at the method of claim 1, which, as a consequence, involves an inventive step.

7. Adaptation of the description

The description has been adapted by submitting at the oral proceedings amended pages 3 and 4, wherein the

statement of the invention in paragraph [0020] has been brought in agreement with the invention claimed in auxiliary request II. As explained hereafter, contrary to the appellant's opinion, no further amendments are necessary.

Paragraph [0019] relates to the possibility of refurbishing a component by recovering the alloy constitution without incipient melting, i.e. an advantage of the claimed invention which applies also to the invention as claimed in auxiliary request II.

In the heat treatment process S102, referred to in paragraphs [0040] and [0059], the cooling phase is in accordance with claim 1 of auxiliary request II (see last sentence of paragraph [0040]). Hence, it is correct to refer to the method comprising the process S102 as an "embodiment" (see paragraph [0059]) and no further adaptation is needed for these paragraphs.

According to the appellant, Figure 2 shows a recovery heat treatment cycle whose heating part is not in accordance with claim 1. Notwithstanding the fact that, for the reasons explained above, the Board does not share this view, this alleged discrepancy between the description would not be caused by the amendments post-grant but would apply also to the patent as granted. Hence, this objection is not admissible.

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 in amended form on the basis of the following documents:

claims
1 to 15 according to auxiliary request II filed with letter of 13 July 2015

description
pages 3 and 4 filed during the oral proceedings
pages 2 and 5 to 11 of the patent specification

figures
1 to 10 of the patent specification

The Registrar: The Chairman:

C. Moser I. Beckedorf

Decision electronically authenticated