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**Datasheet for the decision  
of 14 May 2018**

**Case Number:** T 0435/15 - 3.2.08

**Application Number:** 09250652.6

**Publication Number:** 2105244

**IPC:** B23P6/00, B23K9/04, B23K26/34,  
F01D5/00

**Language of the proceedings:** EN

**Title of invention:**  
Method of restoring an airfoil blade

**Patent Proprietor:**  
United Technologies Corporation

**Opponent:**  
Siemens Aktiengesellschaft

**Headword:**

**Relevant legal provisions:**  
EPC Art. 54, 56

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

**Decisions cited:**

**Catchword:**



**Beschwerdekammern**  
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Case Number: T 0435/15 - 3.2.08

**D E C I S I O N**  
**of Technical Board of Appeal 3.2.08**  
**of 14 May 2018**

**Appellant:** Siemens Aktiengesellschaft  
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**Decision under appeal:** **Decision of the Opposition Division of the  
European Patent Office posted on 11 February  
2015 rejecting the opposition filed against  
European patent No. 2105244 pursuant to Article  
101(2) EPC.**

**Composition of the Board:**

**Chairwoman** P. Acton  
**Members:** M. Foulger  
C. Schmidt

## **Summary of Facts and Submissions**

I. With the decision posted on 11 February 2015 the opposition division rejected the opposition against European patent No. 2 105 244 B1. The opposition division found that the subject-matter of independent claims 1 and 10 was new and involved an inventive step.

II. The appellant (opponent) filed an appeal against this decision.

III. The Board invited the parties to oral proceedings to take place on 21 August 2018. With letter dated 25 January 2018 the appellant withdrew their request for oral proceedings and informed the Board that they would not attend the oral proceedings. Subsequently, the Board cancelled the oral proceedings with the communication dated 19 April 2018.

IV. The requests are as follows:

The appellant requests that the patent be revoked.

The respondent (patent proprietor) requests that the appeal be dismissed, or in the alternative that the patent be maintained in amended form according to the first or second auxiliary request. Oral proceedings were requested before any decision were to be taken not to allow the respondent's main request.

V. Claim 1 of the patent (main request) reads as follows:

"A method of repairing an airfoil blade (10), comprising the steps of:

(A) providing the airfoil blade (10) having a leading edge (18), a trailing edge (22), a tip (26) and a base

(30), a length (L) of the airfoil blade (10) defined by the tip (26) and the base (30) and a width (W) of the airfoil blade (10) defined by the leading edge (18) and the trailing edge (22);

(B) welding in a first direction (A) along the length (L) of the airfoil blade (10) and welding in a second direction (B) transverse to the first direction (A) and along the width (W) of the airfoil blade (10) to form a first weld layer (34) having a first portion (38) extending across the length (L) and a second portion (42) extending across the width (W) to restore at least a portion (74) of the length (L) and a portion (78) of the width (W) of the airfoil blade (10); and

(C) welding a second weld layer (54) on to the first weld layer (34) such that an end wall (58) of the second weld layer (54) abuts the second portion (42) of the first weld layer (34); **characterised by** including the step of:

(D) welding a third weld layer (62) on to the second weld layer (54) such that an end wall (66) of the third weld layer (62) abuts the second portion (42) of the first weld layer (34)."

Claim 10 of the patent (main request) reads as follows:

"An airfoil blade (10), comprising:

an airfoil body having a leading edge (18), a trailing edge (22), a tip (26) and a base (30), a length (L) of said airfoil body (10) defined by said tip (26) and said base (30) and a width (W) of said airfoil body (10) defined by said leading edge (18) and said trailing edge (22);

a first weld layer (34) having a first portion (38) extending across said length (L) and a second portion (42) extending across said width (W) restoring at least a portion (74) of said length (L) and a portion (78) of

said width (W) of said airfoil blade (10) wherein said first weld layer (34) has a first surface in contact with said airfoil blade (10) and a second surface spaced from said first surface; and a second weld layer (54) disposed on said first weld layer (34) such that an end wall (58) of said second weld layer (54) abuts said second portion (42) of said first weld layer (34) on said second surface of said first weld layer (34); **characterised by** including a third weld layer (62) disposed on to said second weld layer (54) such that an end wall (66) of said third weld layer (62) abuts said second portion (42) of said first weld layer (34) on said second surface of said first weld layer (34)."

The other requests are not relevant for this decision.

VI. The following documents are referred to in this decision:

D1: EP 1 153 699 A2  
D2: EP 1 688 211 A2  
D3: JP 2002066745 A  
D4: EP 1 672 170 A1  
D5: EP 1 785 583 A2  
D6: US 2005/0029235 A1  
D7: Khromchenko et al., "Technology of repairing working blades of steam turbines. Part 1. Repair by the method of deposition of high-Cr alloys",  
D8: JP 08323473 A and abstract

VII. The appellant argued essentially the following:

a) Novelty

D7 disclosed a method of repairing an airfoil blade as

well as an airfoil blade. As shown in fig. 5, all of the welding layers ran along the length of the blade before following the width of the blade. All the layers met at a single point, so that at this point all subsequent layers abutted the first layer.

Therefore all features of claims 1 and 10 were known from D7.

b) Inventive step

i) Prior art cited in the patent as closest prior art

The patent cited as prior art a method whereby the welding was carried out parallel to the longitudinal direction of the airfoil blade. According to the patent, this prior art method had the disadvantage that the parts of the airfoil blade, where the welding layers abutted, could melt or burn (patent, paragraph [0003]).

According to the patent, the melting or burning of the blade material could be avoided by applying a first layer which followed the machined surface of the airfoil blade. Subsequent welding layers were applied along the length of the blade such that they abutted the first layer in an area where the first layer no longer ran parallel to the longitudinal direction of the blade.

The patent did not explain why it was favourable for the second and subsequent layers to be linear, it was however obvious for the skilled person that linear welding was easier to control.

The problem to be solved was therefore to reduce the

problems associated with excessive heat input whilst retaining the advantages of linear welding.

D1 taught that, to avoid melting or burning of the base material, the welding pass should start and terminate outside of the machined repair notch (see D1, paragraph [0046]). In the method of D1, the first welding pass ran along the length of the blade before following the width of the blade.

The skilled person would wish to further develop the prior art shown in the patent but without foregoing the advantages of linear welding. They would have therefore applied the teaching of D1 to the first layer in the method of the prior art. In so doing they would have arrived at the subject-matter of claims 1 and 10 without the exercise of inventive activity.

ii) D1 as closest prior art

D1 disclosed all features of claim 1 with the exception of the feature whereby an end wall of said third weld layer abutted said second portion of said first weld layer on said second surface of said first weld layer.

Starting from D1, the problem identified in the patent had already been solved. The skilled person would however seek to improve the efficiency and speed of the welding process.

D8 taught that it was possible to first of all follow the contour of a workpiece before adding linear layers. This had the effect of shortening the working time for cladding (see D8, abstract). In D8 several layers were applied which followed the recess contour. Claim 1 of the patent did not however specify the first layer was



applied to the base material of the blade. The method of D8 had the advantage of shortening working time for cladding (see abstract).

Therefore, in order to solve the above problem the skilled person would have applied the teaching of D8 to that of D1 and would have thereby arrived at the subject-matter of claim 1 without the exercise of inventive activity.

Moreover, the use of linear weld cladding was known from D2 (see figs. 4 and 5), D3 (see fig. 5), D5 (see abstract) and D6 (see fig. 6). A weld cladding process which followed the contour of the workpiece was known from D4 (see fig. 1c).

Given the above, the subject-matter of claims 1 and 10 did not involve an inventive step.

VIII. The respondent argued essentially the following:

a) Novelty

Fig. 5 of D7 was of poor quality so it was not possible to see how the first, second and third layers terminated and thus what they abutted onto. Even if the figure were to be interpreted as showing that these layers terminated in a single point, as argued by the appellant, then the subject-matter was new because the claim required that the second and third layer abutted a portion of the first layer that extended across the width of the blade. In the figure, this single point is however beyond the width of the blade and thus was clearly not a portion of the first layer that extended across the width of the blade.

The same reasoning applied to claim 10.

Therefore the subject-matter of claims 1 and 10 was new with respect to D7.

b) Inventive step

i) Prior art cited in the patent as closest prior art

The subject-matter of claims 1 and 10 was distinguished from the blade and the repair method illustrated in fig. 1 in that a first weld layer had both a portion that extended along the length of the blade and a second portion that extended along the width of the airfoil blade transverse to the direction of the first portion and in that end walls of second and third weld layers abutted the second portion of the first weld layer.

The problem to be solved was to provide a method of repairing an airfoil blade and an airfoil blade in which heat damage during weld repair was minimised.

To solve this problem, the skilled person may well have referred to D1. However, D1 identified the problem of weld defects attributable to starting and stopping of the weld process (see paragraphs [0046]-[0054] of D1). D1 taught away from having second and third layers having end walls which abutted the first layer as required by claims 1 and 10 because D1 taught that each welding pass should terminate outside the repair notch.

Hence, the skilled person would not have arrived at the subject-matter of claims 1 and 10 without inventive step activity when starting from the prior art acknowledged in the patent and taking the teaching of

D1 into consideration.

ii) D1 as closest prior art

D1 taught that the weld layers should start and stop at tabs 44,46 provided outside the repair notch. Hence, D1 did not disclose the method step of claim 1 of welding a third weld layer on to the second weld layer such that an end wall of the third weld layer abutted the second portion of the first weld layer.

The objective technical problem could be seen as being to further reduce the risk of thermal damage to the blade.

The skilled person would not have referred to D8 because this document related to welding of carbon steel structures which suffered from specific welding issues different to those encountered during airfoil repair as airfoils were made from more sophisticated materials.

There was therefore no teaching in D8 that would have incited the skilled person to modify the airfoil of D1 in the expectation of solving the above technical problem.

The same reasoning applied to claim 10.

Therefore the subject-matter of claims 1 and 10 involved an inventive step in view of D1 as the closest prior art.

## **Reasons for the Decision**

### 1. Admissibility

The appeal is admissible. It appeal was filed in due form and within the given time limits.

### 2. Novelty

Claims 1 and 10 relate to a method of repairing an airfoil blade and an airfoil blade respectively. Both require that the end walls of the second and third weld layers abut a portion of the first weld layer which extends across the width of the airfoil blade.

D7 discloses a method of repairing an airfoil blade wherein the weld layers run parallel to the recess in the blade (see D7, fig. 5). The layers terminate in an indistinct weld mass which the appellant refers to as a single point. This single point is outside the repair notch. Consequently, this single point does not extend across the width of the blade, so even if this single point could be regarded as being a portion of the first layer, D7 does not disclose that the end walls of the second and third weld layers abut a portion of the first weld layer which extends across the width of the airfoil blade.

Moreover, the single point is so indistinct in fig. 5 that no conclusion may be drawn as to where the end walls of the second and third weld layers terminate and what they abut onto.

The subject-matter of claims 1 and 10 is therefore new.

3. Inventive step

3.1 Prior art cited in the patent as closest prior art

The prior art cited in the patent (see paragraph [0003] and fig. 1) refers to a method whereby weld layers are applied exclusively longitudinally along the length of the blade.

The subject-matter of claim 1 differs from this known method in the steps of:

welding in a second direction transverse to the first direction and along the width of the airfoil blade to form a first weld layer having a second portion extending across the width,

(C) welding a second weld layer on to the first weld layer such that an end wall of the second weld layer abuts the second portion of the first weld layer,

(D) welding a third weld layer on to the second weld layer such that an end wall of the third weld layer abuts the second portion of the first weld layer.

Method steps C and D of claim 1 are not known from the prior art cited in the patent because in this prior art there is no second portion extending across the width of the blade.

The problem to be solved is to provide a repair method which avoids overheating and burning of the blade.

D1 does indeed describe a method of repairing blades. However D1 (see paragraphs [0046] and [0047]) teaches that each welding pass should be initiated and terminated outside the repair notch because of weld defects at the striking and termination points.

Thus, if the skilled person would apply the teaching of D1 to the prior art cited in the patent, they would arrive at a method where the welds began and ended outside the repair notch. They would not therefore arrive at the feature that the end wall of the third weld layer abuts the second portion of the first weld layer.

The skilled person would not therefore arrive at the subject-matter of claim 1 with regard to the prior art cited in the patent combined with the teaching of D1.

### 3.2 D1 as closest prior art

D1 discloses a method with the features of the preamble of claim 1 except the features whereby the second and third layers abut the a first layer along the width of the airfoil.

As the end wall of the second layer is outside the width of the blade and thus cannot abut the second portion of the first layer which is forcibly within the width of the blade. It follows that the feature of the preamble, whereby an end wall of the second weld layer abuts the second portion of the first weld layer, is not known from D1.

If one follows the argumentation of the appellant, the problem to be solved is to improve the efficiency and speed of the welding process.

D8 does indeed teach a method which aims to shorten working time for cladding (see abstract). This method is however directed to cladding by welding in carbon steel (see title). Moreover the skilled person would be dissuaded from considering D8 by the fact that the

linear welds are initiated and terminated in the recess which D1 specifically teaches against (see paragraphs [0046] and [0047]). Hence, the skilled person, starting from D1 as closest prior art, would not consider D8.

Moreover, the other documents cited do not disclose the feature that an end wall of the third weld layer abuts the second portion of the first weld layer. Thus even considering these documents would not lead the skilled person to the subject-matter of claim 1.

### 3.3 Claim 10

The same reasons apply *mutatis mutandis* to the airfoil blade according to claim 10. Hence, the subject-matter of claim 10 also involves an inventive step.

## Order

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

The appeal is dismissed.

The Registrar:

The Chairwoman:



C. Moser

P. Acton

Decision electronically authenticated