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D E C I S I O N
of 9 November 1993

Case Number: T 0484/91 - 3.2.5

Application Number: 86306129.7

Publication Number: 0212921

IPC: B23K 9/225

Language of the proceedings: EN

Title of invention:
Method for repairing a steam turbine or generator rotor

Patentee:
Westinghouse Electric Corporation

Opponent:
Siemens AG

Headword:
-

Relevant legal norms:
EPC Art. 56

Keyword:
"Inventive step (yes)"

Decisions cited:
-

Catchword:
-

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Beschwerdekammern | Boards of Appeal | Chambres de recours

Case Number: T 0484/91 - 3.2.5

D E C I S I O N
of the Technical Board of Appeal 3.2.5
of 9 November 1993

Appellant: (Proprietor of the patent)
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Respondent: (Opponent)
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Representative:
-

Decision under appeal: **Decision of the Opposition Division of the European Patent Office dated 18 April 1991 revoking European patent No. 0212921 pursuant to Article 102(1) EPC.**

Composition of the Board:

Chairman: C.V. Payraudeau
Members: H.J. Seidenschwarz
A. Burkhart

Summary of Facts and Submissions

I. The appellant (proprietor of the patent) appealed against the decision of the Opposition Division, by which the European patent No. 0 212 921 had been revoked on the ground that its subject-matter did not involve an inventive step with respect to the teachings disclosed by the following documents:

D2: DE-A-2 633 829,
D3: DE-B-2 061 894,
D4: EP-A-0 033 484,
D5: "Experiences with weld repair of low pressure steam turbine rotors"; Proceedings of the American Power Conference, Chicago, Illinois, USA, 22-24 April 1985, pages 213 to 218.

II. Oral proceedings were held.

(i) During these oral proceedings the appellant filed a new Claim 1, which was not formally objected to by the respondent (opponent), and a new page 2 of the description for adapting this description to the new Claim 1.

This claim reads as follows:

"1. A method for repairing low alloy steel large machinery rotors wherein: mating attachments on a replacement end and a remaining portion of the original rotor are fittingly machined, and said replacement end and said original rotor are mated, said replacement end is welded to said original rotor by narrow-gap arc welding up to a depth of 1.27-5.1 cm from the rotor surface, and the welding is continued, to the rotor surface,

by gas tungsten arc welding, and at least the inner 6.3 mm of the weld, together with the mating attachments, are bored out and said weld is inspected through said bore."

(ii) The appellant's and the respondent's submissions can be summarised as follows:

According to the appellant, the subject-matter of the new Claim 1 is limited in its scope and is clearer with respect to the subject-matter as defined in Claim 1 of the patent as granted. He contested the respondent's submissions that the documents D2, D3 and D5 suggested using a combination of welding methods and boring out the inner weld together with the mating attachments as specified in new Claim 1.

The respondent objected to the admissibility of the appeal since the appellant did not substantiate his appeal with respect to the main issue of the decision under appeal, namely the lack of inventive step. Then he argued that document D5 did not recommend *expressis verbis* but did teach implicitly the combination of two of the welding methods as described in this document, since it would be obvious to the person skilled in the art to use the known properties of a narrow-gap arc welding on the interior of a narrow gap weld and the gas tungsten arc welding on a shallow groove on the surface of a rotor because of its good weld mechanical properties. Furthermore, the person skilled in the art, who knew the teaching of document D5 got enough information to apply this teaching with corresponding effect to the methods as disclosed by the documents D2 and D3.

Having regard to providing the welded rotor with an inspection bore as specified in new Claim 1, the respondent was of the opinion that such a bore was a general requirement for the person skilled in the art if he wanted to avoid anything in the interior of the weld around the rotor centre line which could cause crack initiation.

(iii) Finally, the appellant requested that the decision under appeal be set aside and that the patent be maintained in amended form on the basis of new Claim 1 filed during the oral proceedings, Claims 2 and 3 of the patent as granted, page 2 of the description as filed during the oral proceedings, pages 3 and 4 of the description of the patent as granted and the drawings of the patent as granted.

The respondent requested that the appeal be dismissed, firstly as being inadmissible for lack of sufficient substantiation and secondly as not allowable for lack of inventive step.

Reasons for the Decision

1. *Admissibility*

The appeal complies with all the requirements of Articles 106 to 108 and Rule 64 EPC. In particular, the Board can follow the arguments of the appellant set out in his Statement of Grounds with respect to the reasons for the impugned decision, since he clearly refers to the differences which exist in his view between the subject-matter of Claim 1 and the prior art as disclosed

by the documents D2, D3 and D5, and clearly explains why, in his view, the teachings of these documents do not suggest the invention. Therefore, the appeal is admissible.

2. *Amendments*

2.1 Concerning the amendment that the inner 6.3 mm of the weld is bored out "together with the mating attachments", this is referred to on page 2, lines 8 to 13 and page 3, lines 22 to 24 of the originally filed description. This amendment concerns a further restriction of the subject-matter of Claim 1 with respect to the prior art.

2.2 The replacement of the erroneous feature that "the remaining 1.27-5.1 cm of the mating attachment are welded" by the feature that "and the welding is continued to the rotor surface" is a clarifying amendment, which is based on the originally filed description, page 5, lines 3 to 8 in connection with figure 1.

2.3 Rule 29(1) EPC stipulates that the claims should "wherever appropriate" be formulated in two parts. In the present case, however, the Board considers a two-part claim is not appropriate since this form gives a misleading picture of the prior art.

2.4 The amendments on page 2 of the description correspond to the amendments in Claim 1.

2.5 Therefore, the patent in suit, in its present form, complies with Article 123(2) and (3) EPC.

3. *Invention*

The invention relates to a method of repairing large machinery rotors by welding of replacement ends to remaining portions of the original rotors.

It is the object of the subject-matter of this invention to provide a method of repairing large rotors which method is relatively fast but yet of the highest quality and which permits the verification of the repair quality.

This technical problem is solved by the steps of the method as specified in Claim 1.

In particular, the invention makes use of the advantages of two different welding processes such as the very high deposition rate of the **narrow-gap arc welding** (submerged arc welding or gas metal arc welding) and the highest tensile and impact properties of the **gas tungsten arc welding**. Thus the method as claimed provides the superior properties of the **gas tungsten arc welding** in the critical outer portion of the weld but provides for fast **narrow groove welding** of the inner portion of the weld. This ensures minimal distortion during welding and optimum mechanical properties on the outer surface of the weld where operating stresses are the highest. Furthermore, the boring out of the inner 6.3 mm of the weld together with the mating attachments permits the removal of questionable areas along the rotor centre line which could cause crack initiation and provides a smooth bore surface which makes it possible to inspect the critical inner portion near the rotor centre line of the weld (cf. description of the patent in suit: page 2, lines 1 to 25, 36 to 49; page 2, line 62 to page 3, line 28; page 4, lines 50 to 55).

Summarising, the combination of the features as specified in Claim 1 results in a relatively fast method of high quality which at the same time permits the inspection of the repair quality.

4. *Prior art*

4.1 Document D5

According to this document, three different weld processes, namely submerged arc welding, gas metal arc welding and gas tungsten arc welding, have been developed and qualified to enable the person skilled in the art to make almost any configuration repair weld on any area of a low pressure rotor (cf. document D5: page 213: History of rotor weld program; page 214: Weld process; page 217: Non-destructive examination; page 217: Typical repair weld cycle, Typical repair welds made to date and Conclusions).

Moreover, the method for repairing turbine rotors as disclosed by document D5, also includes the weld preparation machining and the inspection of the weld to verify by a non-destructive examination the quality of the weld.

The conclusion of the authors of document D5 is that with the three qualified weld procedures they can select **the best adapted process** for a given repair. From this and the description of the figures 1 to 7, it is clear that only one type of weld process is used for weld repair of large machinery rotors.

4.2 The use of two welding methods in combination is known from the documents D2 and D3.

Document D2 concerns a method of connecting metallic parts by means of arc fusion welding by producing a low volume welding seam (narrow gap welding), wherein the workpiece parts to be joined and forming a narrow gap are **initially** welded at their butt joint by means of **electron beam welding, plasma arc welding, laser beam welding or argon arc welding** to produce a base seam, and **thereafter** the workpiece flanks forming the narrow gap are united by alternately depositing weld beads at first one and then the other workpiece flank by **submerged arc welding** (Claim 1).

Document D3 relates to a method of manufacturing large machinery rotors by using **electroslag welding** for joining the core zone of sections to be joined and **submerged arc welding** for joining the remaining parts of said sections (cf. Claim 1). This document also refers to the possibility of providing the welded sections with a bore (cf. column 4, lines 1 to 5) without going into any details.

5. *Novelty*

The use of **gas tungsten arc welding** in combination with submerged arc welding for the rotor repair welding and the boring out of the inner 6.3 mm of the weld together with the mating attachments on a replacement end and a remaining portion of the original rotor is not disclosed by any of these documents.

Therefore, it follows that the subject-matter of Claim 1 of the patent as granted is new within the meaning of Article 54 EPC.

6. *Inventive step*

From document D5, the person skilled in the art learns that each of the weld processes dealt with in said document has its own drawbacks such as large grain size or low deposition rate **but that each process produces welds of high non-destructive quality throughout the entire weld volume having mechanical properties which exceed the original rotor**, and that he can select the weld process which he believes is the most suitable for repairing rotors by replacing parts of said rotors. He does not get the suggestion at all that more than one welding process should be used for a single weld.

Therefore, having in mind the teaching of document D5 in particular that a narrow gap arc welding such as submerged arc welding meets the highly restrictive non-destructive requirements of modern advanced melting technology forgings, the person skilled in the art gets the suggestion to apply in the narrow gap welding methods as disclosed by the documents D2 and D3 only the submerged arc welding for producing low volume welding seams in the place of the combination of two welding methods.

There is no hint in any of these documents that gas tungsten arc welding should be substituted to the submerged arc welding and this submerged arc welding should be substituted to the welding processes used for joining the core zones of the parts to be welded.

The teaching of document D5, either alone or in combination with the teachings of the documents D2 and D3, clearly does not lead to the teaching of Claim 1 of the patent in suit according to which two different

types of welding processes adhere to very precisely specified dimensional values which give optimum weld joints.

7. Therefore, the subject-matter of Claim 1 involves an inventive step within the meaning of Article 56 EPC. Claims 2 and 3 are dependent upon Claim 1 and are therefore patentable. The patent can thus be maintained as amended.

Order

For these reasons, it is decided that:

1. The decision under appeal is set aside.

2. The case is remitted to the first instance with the order to maintain the patent on the basis of the request of the appellant.

The Registrar: The Chairman:

A. Townend C. Payraudeau