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D E C I S I O N
of 6 March 2003

Case Number: T 0268/01 - 3.2.2

Application Number: 96900129.6

Publication Number: 0804623

IPC: C21D 9/04

Language of the proceedings: EN

Title of invention:
Method for producing carbide-free bainitic steels

Applicant:
Corus UK Limited

Opponent:
-

Headword:
-

Relevant legal provisions:
EPC Art. 52(1), 54, 56, 84

Keyword:
"Clarity (yes), novelty (yes), remittal to first instance"

Decisions cited:
-

Catchword:
-

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Case Number: T 0268/01 - 3.2.2

D E C I S I O N
of the Technical Board of Appeal 3.2.2
of 6 March 2003

Appellant: Corus UK Limited
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Decision under appeal: **Decision of the Examining Division of the European Patent Office posted 16 October 2000 refusing European patent application No. 96 900 129.6 pursuant to Article 97(1) EPC.**

Composition of the Board:

Chairman: W. D. Weiß
Members: S. S. Chowdhury
J. C. M. De Preter

Summary of Facts and Submissions

I. This appeal is against the decision of the examining division dated 16 October 2000 to refuse European patent application No. 96 900 129.6.

The ground of refusal was that the application did not comply with the clarity requirement of Article 84 EPC. The examining division argued that the expression "carbide free bainite" was ambiguous since any form of bainite also embraced iron carbides in one form or another.

During the examination procedure the examining division had also raised objections under Article 52(1) EPC, citing the following documents:

D1: JP-A-6 316 728

D2: EP-A-0 612 852

D3: DE-B-2 302 865

II. On 15 November 2000 the appellant (applicant) lodged an appeal against the decision and paid the prescribed fee on the same day. On 21 February 2001 a statement of grounds of appeal was filed.

With the grounds of appeal the appellant submitted the following document:

Bainite in Steels, H. K. D. H. Bhadeshia, Cambridge University Press, 1992, pages 12, 371 to 373, 378, 379, 381, 382, 385 (hereinafter D4).

III. The appellant requests that the decision under appeal be set aside and that a patent be granted on the basis of the following documents:

- Claims 1 to 4 submitted by telecopy of 25 February 2003, or

- on an auxiliary basis, remittal to the first instance for further prosecution.

IV. Independent claim 1 reads as follows:

"A method of producing a wear and rolling contact fatigue resistant carbide-free bainitic steel rail, the method comprising the steps of hot rolling to shape a steel whose composition by weight includes from 0.05 to 0.50% carbon, from 1.00 to 3.00% silicon and/or aluminum, from 0.50 to 2.50% manganese, from 0.25 to 2.50% chromium, from 0 to 3.00% nickel; from 0 to 0.025% sulphur; from 0 to 1.00% tungsten; from 0 to 1.00% molybdenum; from 0 to 3% copper; from 0 to 0.10% titanium, from 0 to 0.50% vanadium; and from 0 to 0.005% boron, balance iron and incidental impurities, and continuously cooling the rail from its rolling temperature to ambient temperature naturally in air to produce the required wear and rolling contact fatigue resistant carbide-free bainitic steel rail."

Claims 2 to 4 are dependent on claim 1.

V. The appellant argued as follows:

The description explained what was meant by "carbide free bainite" and the examining division had no problems with this expression in the earlier part of

the examination procedure. Bainite was a mixture of bainitic ferrite and carbon enriched residual austenite, which latter transformed to carbide. In specific steel chemistries the carbide reaction could be suppressed and a complex microstructure produced consisting of bainitic ferrite containing no carbides, carbon enriched austenite, and high carbon martensite. Since bainitic ferrite was the major component of this microstructure it was called "carbide free bainite". D4 explained this expression clearly.

Reasons for the Decision

1. The appeal is admissible.

2. *Amendments*

Claim 1 is essentially a combination of claims 1 and 2 as originally filed, with some editorial changes, and the claimed method has been limited to the case of cooling the rail naturally in air, ie the case of accelerated cooling is no longer claimed as an option. The new claim relates to a method of producing a "rail" while the original claim related to a method of producing a "steel product", and the new claim specifies that the rail is cooled from its rolling temperature to ambient temperature. All these amendments are supported by the application as originally filed.

The dependent claims 2 to 4 correspond to original claims 3 to 5, respectively. There is no formal objection to the new claims, accordingly.

3. *Clarity*

3.1. The expression "carbide free bainite" is explained in the description, mainly on page 3. It is stated that in steel with high (> 1.00%) silicon and/or aluminium content the steel is continuously transformed to bainite with the retention of high carbon austenite regions, the residual austenite then transforming to carbide. With a careful choice of steel composition and heat treatment, in particular a continuous cooling transformation in the bainitic temperature range, an essentially carbide free, "upper bainite" type microstructure based on bainitic ferrite, residual austenite and high carbon martensite can be attained.

Page 3 also describes the mechanism for the formation of the carbide free bainite, which is that the carbide reaction is suppressed and the carbon enriched austenite is transformed to martensite on cooling so that the bainitic ferrite contains no carbides. Instead it contains carbon enriched austenite and high carbon martensite.

This is supported by D4. The author of this article is also one of the inventors of the present application, and he holds a post in a renowned educational institute and is clearly an authority on the subject, and the Board see no reason for contradicting his statement. For these reasons the Board does not see any ambiguity in the expression "carbide free bainite", and the claims are clear in this respect.

4. Although the application was refused for non-compliance with Article 84 EPC, the examining division also raised objections to the claims under Article 52(1) EPC during

the examination procedure. The Board exercises its power under Article 111(1) EPC to rule on this point also.

5. *Novelty*

5.1 Three important features of the claimed method are that the method should produce a carbide-free bainitic steel rail, the method involves continuous cooling of the rail from its rolling temperature to ambient temperature, and the cooling is done naturally in air. Regarding the first of these features, in order to ensure the suppression of carbide formation, inter alia, a high silicon content of 1.00 to 3.00% is used in the steel.

5.2 The expression "continuously cooling" is not defined expressly in the application nor is it illustrated by an example. However, the application (see page 2) draws a distinction between the cooling regimen of the application and that of the prior art reviewed on pages 1 and 2, in which two distinct cooling rates are used. For example, in D2 a first, accelerated cooling rate from the hot rolling temperature to an intermediate temperature and a second cooling rate to a lower temperature are used. Alternatively, the cooling is interrupted by another processing step such as annealing, as in D3. From this it may be concluded that "continuously cooling" means that there is no discontinuity in the temperature/time cooling curve of the steel.

Such a discontinuity would be produced by the prior art cooling method used in document D2 where two distinct cooling rates are used, or where the cooling between

the rolling temperature and ambient temperature is interrupted by an annealing step.

In document D1 an accelerated cooling step is employed, and the steel has a silicon content of 1.00% or less, so that carbides are formed, as described in paragraph [0009] of the English translation of D1.

5.3 In document D2 the cooling is discontinuous in that it involves first an accelerated cooling to an intermediate temperature and then further cooling down to room temperature. Moreover, the formation of carbides is not suppressed, as indicated at page 4, lines 13 to 19, for example.

D3 discloses a process for producing bainitic steel rails, the steel having a composition falling within the terms of claim 1, which rails are naturally cooled from the hot rolling temperature to form a bainitic structure. The rails are subsequently annealed in a temperature range of 450 to 600°C for up to one hour and then allowed to cool to ambient temperature. The aim of D3 is to produce an untempered, high tensile strength and tough rail with high wear resistance, in which the presence of carbides in the bainitic structure is not considered deleterious.

The examining division argued that in D3 the same process as the claimed process is carried out, starting from the same steel composition, so that a carbide-free bainitic steel would inevitably be produced. This argument is flawed since the examining division cites the method of production of an intermediate product of the process of D3 against method of production of the final product of the method of claim 1 of the

application.

5.4 Moreover, bainite is not in equilibrium at room temperature and the step of annealing the cooled steel for half an hour at 450°C will transform the structure and create carbides. The applicant has produced the results of a trial in which a steel plate having the composition specified in D3 was tempered for 30 minutes at 450°C. An electron micrograph of foils prepared from the tempered steel plate revealed an extensive distribution of iron carbides within the bainitic structure.

5.5 Thus, none of documents D1 to D3 aims at producing a carbide-free bainitic structure, and none of D1 to D3 includes all the three essential features mentioned in point 5.1 above. The claimed method is, therefore, novel.

6. *Inventive step*

The document D4 imports new technical information that was not available to the examining division. The new technical information now on file is relevant to the question of inventive step in that it shows for the first time, as far as the present application is concerned, that it was known in the prior art that carbide-free bainitic rail steels exhibit wear resistance significantly better than conventional alloys.

7. The appellant wishes that the new information should first be considered by the examining division. Since the appellant requests the benefit of two instances, its request for remittal to the first instance for

further prosecution in this respect is granted in accordance with Article 111(1) EPC.

Order

For these reasons it is decided that:

1. The decision under appeal is set aside.

2. The case is remitted to the examining division for further prosecution.

The Registrar The Chairman

V. Commare W. D. Weiß