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**Datasheet for the decision  
of 11 May 2010**

**Case Number:** T 1059/08 - 3.2.08

**Application Number:** 03396059.2

**Publication Number:** 1375694

**IPC:** C22C 38/18

**Language of the proceedings:** EN

**Title of invention:**

Hot-rolled steel strip and method for manufacturing the same

**Patentee:**

RAUTARUUKKI OYJ

**Opponent:**

ThyssenKrupp Steel AG

**Headword:**

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**Relevant legal provisions:**

EPC Art. 54, 56

**Relevant legal provisions (EPC 1973):**

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**Keyword:**

"Novelty (yes)"

"Inventive step (yes)"

**Decisions cited:**

-

**Catchword:**

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Case Number: T 1059/08 - 3.2.08

**DECISION**  
of the Technical Board of Appeal 3.2.08  
of 11 May 2010

**Appellant:** ThyssenKrupp Steel AG  
(Opponent) Kaiser-Wilhelm-Strasse 100  
D-47166 Duisburg (DE)

**Representative:** Simons, Johannes  
COHAUSZ & FLORACK  
Patent- und Rechtsanwälte  
Partnerschaftsgesellschaft  
Bleichstrasse 14  
D-40211 Düsseldorf (DE)

**Respondent:** RAUTARUUKKI OYJ  
(Patent Proprietor) P.O. Box 860  
FI-00101 Helsinki (FI)

**Representative:** Laako, Tero Jussi  
Berggren Oy Ab  
P.O. Box 16  
FI-00101 Helsinki (FI)

**Decision under appeal:** Interlocutory decision of the Opposition  
Division of the European Patent Office posted  
17 March 2008 concerning maintenance of  
European patent No. 1375694 in amended form.

**Composition of the Board:**

**Chairman:** T. Kriner  
**Members:** R. Ries  
A. Pignatelli

## Summary of Facts and Submissions

I. Oppositions were filed against European patent No. 1 375 694 as a whole by opponent OI (SSAB Tunnelplat AB) and by the present appellant opponent OII (ThyssenKrupp Steel AG). The oppositions were based on Article 100 a) EPC (lack of novelty and lack of inventive step).

In its interlocutory decision dispatched on 27 March 2008, the opposition division held that the subject matter of the claims according to the main request then on file met the requirements of the EPC and that the patent could be maintained in amended form on the basis of this request.

Opponent OII lodged an appeal against this decision on 6 June 2008. The appeal fee was paid on the same date. The statement setting out the grounds of appeal was received on 6 August 2008.

II. On appeal, the following documents have been referred to by the parties:

D1: US-A-6 284 063;

D1a: WO-A-98/02589 corresponding to D1;

D8: US-A-2001/0049956 and

D9: Enclosure 1 submitted by the patent proprietor in reply to the grounds of appeal.

- III. In the official communication dated 4 December 2009 annexed to the summons to oral proceedings, the Board gave its provisional view on the case setting out that the subject matter claimed in the patent was not derivable in an obvious manner from the technical teaching given in document D8 taken alone or in combination with D1/D1a.
- IV. By its letter received at the EPO on 11 December 2009, opponent OI withdrew its opposition.
- V. By its letter dated 25 February 2010, the appellant withdrew its request for oral proceedings and declared that, having regard to the Board's provisional assessment of the case, no further comments would be submitted.
- VI. Likewise, by its letter dated 24 March 2010, the patent proprietor (respondent) withdrew its requests for oral proceedings and for apportionment of costs.
- VII. On 16 April 2010, the Board informed the parties that the oral proceedings scheduled for the 27 April 2010 were cancelled.
- VIII. The following requests were made:
- The appellant requested that the decision under appeal be set aside and the patent be revoked.
  - The respondent requested that the appeal be rejected.

Independent claims 1 and 2 underlying the decision of the opposition division read as follows:

"1. A steel strip having a microstructure comprising martensite and/or bainite, and where the steel contains, in percentages by weight: 0.08% - 0.16% C, 0.5% - 1.5% Cr and/or 0.1% - 0.5% Mo, 0.6% - 1.1% Mn,  $\leq$ 0.015% S and  $\leq$ 0.03% P, 0.01% - 0.08% Al, 0.1% - 0.3% Si, 0.0005% - 0.005% B and 0.01% - 0.1% Ti, the rest being Fe and unavoidable impurities; the tensile strength of the strip being 700 Mpa - 1500 Mpa with a tensile elongation, the A5 of which is at least 6%; wherein the steel strip is a hot rolled steel strip rolled to a final thickness of at least 2 mm but no more than 12 mm; the microstructure comprises at least 95% martensite and/or bainite; the yield strength is 600 Mpa - 1400 Mpa; and said hot rolled steel strip has yield ratio within the range 0.8 to 0.96."

"2. A method for manufacturing a steel strip having a microstructure comprising at least 95% martensite and/or bainite, said steel containing in percentages by weight: 0.08% - 0.16% C; 0.5% - 1.5% Cr and/or 0.1% - 0.5% Mo; 0.01% - 0.08% Al; 0.6% - 1.1% Mn; 0.1% - 0.3% Si, 0.0005% - 0.005% B, and 0.01% - 0.1% Ti, as well as the rest Fe and unavoidable impurities, the steel strip being hot-rolled in the temperature range 860°C - 960°C, wherein the method includes the following steps:

- said hot-rolling in said temperature range provides a final thickness of at least 2 mm but no more than 12 mm for said steel strip;
- this hot-rolled steel strip is directly quenched with a delay no longer than 15 seconds from the last rolling pass to a coiling temperature in the range 100°C - 520°C, so that the cooling rate in this direct quenching is at least 30°C/s."

IX. The appellant's arguments can be summarized as follows:

In the opposition division's view, the composition of the steel strip of D8 was distinguished from that claimed in the patent - apart from the absence of precise ranges for Ti and B - by a different concept based on the purposive addition of vanadium. Accordingly, in D8 specific amounts of V were needed to form precipitates of nitride and carbide type in order to promote hardening and high level of mechanical properties of the steel strip but without increasing the hardness when hot. The steel concept based on V thus allowed high reduction rates during hot rolling to produce thin steel sheet.

The opposition division, however, disregarded the teaching given in D8, claim 1 and paragraphs [0043] and [0060] which defined vanadium (<0.3%) merely as an optional component that could be absent (= 0% V). Only when producing very thin hot rolled steel sheet down to 1.4 mm thickness, the addition of vanadium, preferably in the range of 0.1 to <0.3%, was recommended to effect hardening of the sheet without increasing the hot rolling efforts.

By contrast, the thickness of the steel sheet claimed in the patent was confined to a range of 2 to 12 mm which was above 1.4 mm and, as taught in D8, did not require the addition of vanadium.

Turning to Ti and B, document D1a related to a steel composition similar to that of D8 and provided additions of 0.012 to 0.024% Ti (corresponding to  $Ti = 3.4 \times \%N$ ) which fell within the claimed Ti range (see

D1, claim 5). This was also true for boron that was added in D1a up to 0.0025% to improve the level of tensile strength. The fact that compared to D8, document D1a was concerned with a steel composition comprising higher amounts of Mn and lower concentrations of Si had no bearing on the matter given that manganese and silicon did not adversely affect the steel properties provided by Ti and B.

As to the claimed yield ratio of 0.8 to 0.96, document D8 disclosed for the vanadium-free steel composition of example A in Table 3 a tensile strength of 790 MPa and a yield strength of 670 MPa, resulting in a yield ratio of 0.85 within the claimed range.

Consequently, the subject matter claimed in the patent as maintained in amended form did not comprise technical features justifying an inventive step.

X. The respondent's arguments can be summarized as follows:

The appellant's technical interpretations of D8 were incorrect. In particular the enclosure (document D9) related to the composition of the bainitic steel strip of D8 and specifically to the role of vanadium. In D9, the inventors of D8 identified vanadium as an essential and compulsory component which was to be present in a range from 0.1 to 0.3%. Consequently, document D8 read as a whole and in particular in the light of the explanations set out in D9 pointed away from choosing a vanadium-free steel strip. The subject matter claimed in the patent thus involved an inventive step.

## Reasons for the Decision

1. The appeal is admissible.
2. Novelty

The composition of the steel sheet set out in claim 1 of the patent is distinguished from that given in document D1/D1a by comprising lower amounts of Mn and higher amounts of Si. Document D8 fails to identify any ranges for titanium and boron which are required in the claimed steel sheet in the range of 0.01 to 0.1 wt% Ti and 0.0005 to 0.005 wt% B. The same statement applies to independent method claim 2.

Hence, there is no doubt about the novelty of the claimed subject matter. Besides, the novelty of the claimed subject matter was not disputed by the appellant either.

3. Inventive step
  - 3.1 The Board concurs with the appellant's position and that of the opposition division qualifying document D8 as representing the closest prior art (see the impugned decision, point 4.2). Like the patent at issue, D8 is concerned with hot rolled bainitic steel strip having a final thickness in the range of 5 mm down to 1.4 mm, a high tensile strength (TS) above 1000 MPa, a yield strength (YS) greater than 700 MPa and an elongation of more than 10 % (see D8, paragraphs [0085], [0086]). The steel sheet is formed by rolling at a temperature below 950°C followed by cooling at a rate of more than 20°C/s,



preferably 100°C/s to 200°C/s, to a temperature ranging from 400°C to 600°C (see D8, claim 3).

Contrary to the hot rolled steel described in claim 1 of D8, the composition of the steel strip set out in claim 1 of the patent at issue additionally comprises 0.01 to 0.1 wt% Ti and 0.0005 to 0.005% wt% B.

According to D8, paragraph [0081], Ti and B are not excluded but may be added to the known composition of the steel strip, possibly in stoichiometric amounts  $Ti = 3.4 \times \%N$  as suggested by the appellant, to promote the precipitation of vanadium carbides and the formation of nitrides at high temperatures.

Specifically, D8 fails to define precise ranges for Ti and B (see D8, paragraph [0081]). With particular respect to hot rolling, however, the technical teaching given in paragraph [0080] of D8 dissuades the skilled metallurgist from adding micro-alloying elements other than vanadium, since elements such as titanium and/or niobium cause an increase in hardness of the steel when hot thus limiting the hot rolling reduction rates and the minimum thickness achievable for this kind of steel.

- 3.2 As to manganese, an overlap of 0.1% exists between the claimed range (0.6 to 1.1% Mn) and that disclosed in D8 (1 to 2% Mn). More preferably, as set out in D8, claim 2 and the examples A to C featuring in Tables 1 and 4, manganese should range from 1.4 to 1.8% Mn which is outside the range for manganese claimed in the patent. The reason for adding Mn is elucidated in D8, paragraph [0071], specifying manganese as a constituent which increases the hardenability while it simultaneously helps to avoid the formation of ferrite due to high cooling speeds. Manganese is therefore an

important element for obtaining an entirely bainite structure. Accordingly, the exemplifying compositions A to C in D8 comprise 1.58% Mn which is far above the range for manganese claimed in the patent.

In this respect, document D8 clearly points away from the inventive idea, addressed in the patent in paragraphs [0010] and [0014], of reducing the amount of manganese to no more than 1.1%. In so doing, the claimed steel structure is not critical for the segregation of manganese and carbon during casting, and the steel properties are not critical for fluctuation of the coiling temperature which facilitates producing the steel and has an advantageous effect on the homogeneity of the mechanical properties, flatness and residual stress.

Given that document D1/D1a likewise proposes a hot rolled steel sheet comprising high amounts of manganese in the range of 1.2 to 2.0 wt%, the combined teaching of documents D8 and D1/D1a does not prompt a skilled person to design the composition of the claimed steel strip, contrary the appellant's position.

- 3.3 In its broadest aspect, the composition of the steel sheet of D8 comprises 0% V to less than 0.3% V and thus identifies V additions as "optional". The appellant's argument that the steel sheet of D8 may be V-free is therefore not disputed. However, the skilled reader is taught by D8 as a whole and in particular by the passages [0075] and [0080] that vanadium actually represents an indispensable component necessary to produce in steel with a bainite structure the desired hardening effect which could not be obtained with other

micro-alloying elements such as Ti and/or Nb. The skilled person is further taught that vanadium significantly enhances the mechanical properties of the steel sheet, without however increasing the hardness and the rolling forces when hot. For this reason, vanadium when added in the defined amounts enables hot rolling the sheet down to a thickness of 1.4 mm. This assessment of the technical teaching of D8 is confirmed by the passage [0076] of D8 which qualifies the vanadium-free steel A in Table 1 as a "comparative example" exhibiting rather low mechanical characteristics compared to example B comprising 0.2% V according to the invention. The Board's evaluation of the contents of D8 is supported also by document D9 wherein the inventors of D8, during substantive examination of the corresponding European patent application before the EPO, unambiguously qualify vanadium as a compulsory and indispensable component which needs to be added between 0.1 to 0.3% in order to obtain the desired objects.

Contrary to the appellant's position, this all goes to show that vanadium has to be judged as being an indispensable rather than an optional element in the known steel sheet.

- 3.4 Turning to the thickness of the steel sheet, reference is made to example B presented in Table 4 and paragraph [0083] which has been rolled down to 1.7 mm, a thickness which is rather close to the lower limit of 2 mm claimed in the patent. Moreover, steel sheet up to a thickness of 5 mm can be produced as set out in D8, paragraph [0086]. Hence, the appellant's

- counterargument with respect to the different thickness of the claimed steel strip and D8 is not convincing.
- 3.5 In conclusion, the overall teaching of document D8, taken individually or in combination with document D1/D1a, points away from producing a hot rolled steel strip having a composition according to claim 1 of the patent at issue.
- 3.6 Since the claimed steel strip per se is novel and inventive with respect to the cited prior art, this finding is also true for the method of manufacturing the steel strip set out in independent claim 2 of the patent.
4. Given this situation, there is no need to deal with the appellant's further arguments, e.g. with the question whether or not the mechanical properties and the yield ratio featuring in claim 1 are disclosed in D8.

## **Order**

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

The appeal is dismissed.

The Registrar:

The Chairman:

V. Commare

T. Kriner