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D E C I S I O N
of 18 January 2005

Case Number: T 0716/02 - 3.2.2

Application Number: 92906721.3

Publication Number: 0691415

IPC: C22C 38/12

Language of the proceedings: EN

Title of invention:
High-strength, cold-rolled steel sheet excellent in formability, hot-dip zinc coated high-strength cold rolled steel sheet, and method of manufacturing said sheets

Patentee:
Nippon Steel Corporation

Opponent:
Thyssen Krupp Stahl AG

Headword:
-

Relevant legal provisions:
EPC Art. 54, 56

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

Decisions cited:
-

Catchword:
-

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Case Number: T 0716/02 - 3.2.2

D E C I S I O N
of the Technical Board of Appeal 3.2.2
of 18 January 2005

Appellant: (Opponent)	Thyssen Krupp Stahl AG August-Thyssen-Strasse 1 D-40211 Düsseldorf (DE)
Representative:	Simons, Johannes, Dipl.-Ing. COHAUSZ & FLORACK Patent- und Rechtsanwälte Postfach 10 18 30 D-40009 Düsseldorf (DE)
Respondent: (Proprietor of the patent)	Nippon Steel Corporation 6-3, 2-chome, Ote-machi, Chiyoda-ku Tokyo 100-0004 (JP)
Representative:	VOSSIUS & PARTNER Siebertstrasse 4 D-81675 München (DE)
Decision under appeal:	**Interlocutory decision of the Opposition Division of the European Patent Office posted 8 May 2002 concerning maintenance of European patent No. 0691415 in amended form.**

Composition of the Board:

Chairman: T. K. H. Kriner
Members: R. Ries
A. Pignatelli

Summary of Facts and Submissions

I. The grant of European patent No. 0 691 415 on the basis of European patent application 92906721.3 was mentioned on 15 December 1999.

II. The granted patent was opposed by the present appellant on the grounds that its subject matter lacked novelty and did not involve an inventive step with respect to the state of the art (Articles 100(a), 54 and 56 EPC), and on the ground of insufficient disclosure (Article 100(b), 83 EPC).

III. With its decision posted on 8 May 2002, the Opposition Division held that the patent could be maintained in amended form on the basis of the set of claims filed at the oral proceedings on 16 April 2002.

The independent claims 1 to 4 read as follows:

"1. A high-strength cold-rolled steel strip and a molten zinc-plated high-strength cold-rolled steel strip which have excellent formability, consisting, by weight, of 0.0005-0.01% C, not more than 0.8% Si, more than 0.5% but not more than 3.0% Mn, 0.2-3.0% Cr, 0.01-0.12% P, 0.0010-0.015% S, 0.01-0.1% Al, 0.0005-0.0060% N, not less than 0.0001% but less than 0.0005% B, 0.005-0.1% Nb, the content of Nb being made to satisfy $Nb \geq 93/12\ (C-0.0015)$, and the balance Fe and incidental impurities."

"2. A high-strength cold-rolled steel strip and a molten zinc-plated high-strength cold-rolled steel strip which have excellent formability, consisting, by

weight, of 0.0005-0.01% C, more than 0.03% but not more than 0.8% Si, more than 0.5% but not more than 3.0% Mn, 0.2-3.0% Cr, 0.01-0.12% P, 0.0010-0.015% S, 0.01-0.1% Al, 0.0005-0.0060% N, 0.005-0.1% Ti, 0.003-0.1% Nb, the content of N and the content of Ti being made to satisfy Ti $\geq$ 3.4N, optionally 0.0001-0.0020% B and the balance Fe and incidental impurities."

"3. A method of producing a high-strength cold-rolled steel strip characterized by the steps of finishing the hot-rolling of a slab, having a chemical composition as claimed in claims 1 or 2, at a temperature of not less than (Ar_3 - 100)°C; coiling it up at a temperature ranging from room temperature to 750°C; cold-rolling it at a rolling rate of not less than 60%; and setting an annealing temperature during continuous annealing to 700~900°C."

"4. A method of producing a molten zinc-plated high-strength cold-rolled steel strip characterized by comprising the steps of finishing the hot-rolling of a slab, having a chemical composition as claimed in claims 1 or 2, at a temperature of not less than(Ar_3 - 100)°C; coiling it up at a temperature ranging from room temperature to 750°C; cold-rolling it at a rolling rate of not less than 60%; and applying molten zinc-plating of an in-line annealing type to the cold rolled steel strip at an annealing temperature of 700~900°C."

IV. An appeal against this decision was filed on 5 July 2002 and the fee for appeal paid on the same date. The statement of grounds was filed on 16 September 2002.

V. Of the documents relied upon in the opposition proceedings, the following have played a significant role during the appeal proceedings:

D1: EP-A-0 375 273

D2: EP-A-0 152 665

D3: F. Fudaba, O. Akisue, Y. Tokunaga: "The Production of IF Sheet Steels for Continuous Annealing", 27th Annual Conference of Metallurgists, August 28-31, 1988, Montreal, Canada, pages 290, 296 to 298

VI. Oral proceedings were held before the Board on 18 January 2005, at the end of which the requests were as follows:

- The appellant (opponent) requested that the decision under appeal be set aside and the patent be revoked.

- The respondent (patentee) requested that the appeal be dismissed.

VII. The appellant argued as follows:

In its broadest aspect, document D1 disclosed the elemental ranges of a steel alloy overlapping with the corresponding ranges of the claimed alloy for the high strength cold rolled steel strip according to claim 1 (cf. D1, claims 1 to 3). This general technical teaching of document D1 needed to be evaluated in combination with the plethora of exemplifying compositions which were given in the Tables 7, 9 and 11 to illustrate the wide variety of alloys including i.a.

Cr and/or Mn containing steel strips (cf. D1, Table 7, No. 4, 8, 9; Table 9, n° 8, 9; Table 11, No. 4, 6, 8). On page 6, document D1 disclosed in detail the effects exerted by the individual constituents upon the final properties of the steel sheet. Based on these general explanations, a skilled person, putting into practice the teaching of D1, would focus his attention not exclusively upon the most preferred embodiments represented by the examples, but would also produce other alloy compositions satisfying the compositional requirements according to D1 and falling within the elemental ranges of the alloy composition set out in claim 1 of the patent. D1 did not disclose chromium containing steels comprising simultaneously manganese in amounts higher than 0.5%. However, as described on page 6, lines 12, 13, manganese could be present up to 1.0%. As can be seen, higher amounts of Mn (0.55%, 0.60% Mn) were used in Cr-free steels no. 4 given in Tables 7 and 9 of D1. Therefore, the claimed steel strip alloy was not sufficiently delimited from the one given in document D1 and, consequently, the subject matter of claim 1 lacked novelty.

Even if the novelty of the subject matter of claim 1 vis-à-vis document D1 was acknowledged, which was denied, the skilled metallurgist knew that the tensile strength of the type of steel sheet under consideration could be increased simply by adding higher amounts of manganese, at least up to 1% according to D1.

With respect to the composition of the steel sheet stipulated in claim 2 of the patent at issue, document D2 as the closest prior art disclosed a Nb and B containing dual phase steel sheet not comprising Ti. It

would, however, take no imagination for a skilled person considering the technical information given in document D3 to modify the alloy known from document D2. Document D3 taught that by adding small amounts of titanium, nitrogen could be fixed as TiN so that the boron added to the steel alloy could be used more effectively. Consequently, the addition of small amounts of Ti to the alloy composition J given in Table 5 of document D2 and satisfying the elemental ranges of the alloy set out in claim 2 was close at hand. A skilled person would have thus arrived in an obvious manner at the claimed alloy composition. Hence the subject matter of claim 2 was obvious from the combined teaching given in documents D2 and D3.

VIII. The respondent argued as follows:

None of documents D1 to D3 disclosed the claimed steel sheet set out in claims 1 and 2. The composition of the steel sheet according to claim 1 was a novel selection from the wide variety of possible steels encompassed in document D1.

As to inventive step, no hint could be found in the prior art documents D1 to D3 to design an alloy having the carefully controlled additions of Cr and Mn in combination with additions of Nb, B and Ti as claimed in the patent so that an improved resistance to denting σ_d = (YP + WH + BH) was successfully achieved.

Reasons for the Decision

1. The appeal is admissible.

2. *The patent*

The patent under consideration relates to a high strength cold rolled steel strip, e.g. for producing the panel of an automobile, which is required to exhibit
- a high tensile strength (TS) but which is not so high in the yield strength (YS),
- a high yield point (YP-El),
- a good formability (deep-drawability),
- a high work-hardenability (WH)
- a high paint bake-hardenability (BH), and
- a non-ageing nature at normal temperature.

In particular, the dent preventing property which means the steel strip's resistance to a permanent dent deformation occurring when a stone strikes against the assembled automotive body and which is expressed by the formula σ_d = (YP + WH + BH) should be high.

This carefully balanced combination of properties is achieved by strictly adhering to the composition of a steel strip specified in independent claims 1 and 2 and by the process steps for producing the steel strip set out in independent claims 3 and 4 of the patent.

3. *Novelty*

With respect to claim 1, it has been common ground between the parties and the Board that document D1 represents the closest prior art. It discloses the

alloy composition of a cold rolled steel sheet overlapping with the composition specified in claim 1 of the patent at issue. Given this situation, it has to be checked (a) whether the composition of the claimed steel sheet satisfies the three postulates for the novelty of a selection, and (b) whether a person skilled in the art would, in the light of the technical facts at his disposal, seriously contemplate applying the technical teaching of the prior art documents D1, D2 or D3 in the range of overlap (cf. Case Law of the Boards of Appeal, 4th edition 2001, I.C.4.2).

Document D1 is concerned with a formable steel sheet comprising ≤0.003% C, ≤1.0% Si, ≤1.0% Mn, ≤0.15% P, ≤0.020% S, ≤0.0020% N, ≤0.15% Al with the ratio Al/N ≥ 30, the balance being Fe and inevitable impurities (cf. D1, claim 1). To the basic steel composition, either or both of 0.001 to 0.025% Nb and 0.0002 to 0.0020% B could be added, as set out in claim 2 of document D1. In addition thereto, Cr up to 1.0% and other elements including Ti, V, Zr, Ca, Cu and Ni could be present as further optional components (see D1, Tables 1, 3, 5, 7 and 9). The comparison shows, that at least with respect to the boron content, the degree of overlap between the claimed steel alloy and the one disclosed in document D1 is small. Having regard to the examples given in Table 11 a and b actually comprising Cr in the claimed amounts, it is noted that manganese is restricted to about 0.15 to 0.22% Mn, i.e. to Mn contents far below the lower limit of the claimed alloy (0.5% Mn). Moreover, none of the examples actually includes chromium and boron and niobium as does the claimed steel sheet. It is, therefore, unlikely that the claimed combination of properties, in particular

the resistance to denting, is actually achieved by the cold rolled steel sheet known from document D1.

Turning to question (b), a skilled person would, in the Board's view, not immediately be led to design a steel composition comprising chromium, niobium and boron in the claimed amounts since nothing can be found anywhere in document D1 implying that such an alloy is particularly preferred. Even supposing that, for the sake of argument, a Mn-Cr-Nb-B containing steel alloy was actually chosen, a skilled person would be led by the exemplifying compositions given in Table 11 to adhere to a low manganese content in the range of 0.15 to 0.22% rather than to select higher amounts of manganese, more so since the addition of excessive amounts of Mn is said in document D1, page 6, lines 12/13 to degrade the elongation and drawability of the steel sheet. Accordingly, the postulates for the novelty of a selection vis-à-vis document D1 are fulfilled.

Given that the boron content to adhere to according to document D2 falls outside the claimed range of 0.0001 to <0.0005% B, the subject matter of claim 1 is novel also vis-à-vis the steel sheet disclosed in document D2.

Document D3 is more remote in that relates to interstitial-free (IF) steel sheet which does not comprise chromium as a compulsory component and fails to specify the Al content of the alloy.

Hence, the subject matter of claim 1 is novel over the technical teaching given in any of documents D1, D2 and D3.

The novelty of the subject matter of independent claims 2, 3 and 4 has no longer been challenged by the appellant at the oral proceedings.

4. *Inventive step*

4.1 Apart from improving the press-formability and deep drawability, document D1 is essentially concerned with increasing the steel sheet's resistance to fatigue at the welded joint and in the heat affected zone (HAZ). To solve this problem, an Al/N ratio ≥ 30 needs to be adhered to in the basic alloy (cf. D1, page 2, lines 31 to 38; claim 1). The addition of one or more elements of the group comprising Nb, B alone or in combination with one or more elements of the group comprising Ti, V, Zr, Ca, Cr, Cu and Ni to the basic composition is possible to further improve the fatigue properties of the welded zone (cf. D1, page 6, lines 31 to 40).

With respect to document D1, the problem underlying the patent at issue resides in increasing effectively the dent resistance σ_d = (YP + WH + BH) rather than improving the alloy's resistance to fatigue in the weld joint and the HAZ aimed at in D1. Contrary to the appellant's allegations, it cannot be fairly assumed that, in the absence of any prior art suggestion or pointer in document D1 to a preferred steel sheet composition comprising Mn, Cr, B and Nb, a skilled person would have tried, simply as a matter of routine, the alloy composition stipulated in claim 1 of the patent.

4.2 The appellant has further developed arguments that the subject matter of claim 2 was obvious from the combined teaching given in documents D2 and D3.

The Board concurs with the appellant's position that, with respect to the steel sheet set out in claim 2 of the patent, document D2 represents the closest prior art. It is concerned with the production of a cold rolled dual phase steel sheet which is suitable for forming automotive panels and which provides an excellent match in a high deep drawability and ductility (press formability), a high BH as well as a high resistance to room temperature aging and, more importantly, to denting, (cf. D2, pages 1 and 2). Specifically, a steel composition comprising Cr, Nb and B with (%Nb + %B) = 0.010-0.080% and B = 0.0005-0.005% has been found to provide the desired combination of properties (cf. in particular D2, pages 11/12). Hence, the object aimed at by the patent at issue is also addressed in document D2. The appellant is right in saying that the composition of steel J given in Table 5 of D2 actually falls within the claimed elemental ranges, but fails to include titanium. Study of document D2, pages 9 to 12, however reveals that D2 provides a carefully balanced steel composition designed i.a. by simultaneously adding very specific amounts of Cr, Nb and B so that the above mentioned match in the mechanical properties is reliably obtained. Such an alloy composition cannot be modified simply by adding or omitting one component. It is known to the expert that the addition of one or several components to a well balanced steel composition runs the risk of adversely affecting the overall performance of the alloy. Due to the interaction of the individual

elements in a steel alloy, a skilled person cannot ultimately evaluate reliably and clearly the effects on the alloy's mechanical properties, in particular the dent resistance σ_d = (YP + WH + BH) that is brought about by the further addition of titanium to the steel composition known from D2. Therefore a skilled person would, in the Board's view, not simply transfer the technical teaching given in document D3 and describing the effect of titanium added to an IF chromium-free Mn-Nb-B-N alloy to the carefully balanced steel alloy disclosed in document D2, more so since document D3 is concerned with a different type of steel (IF steel) which due to the absence of interstitial C and N in solid solution does not exhibit a satisfactory BH property.

Based on these considerations, the Board cannot follow the appellant's reasoning on that point.

The subject matter of claim 2, therefore, involves an inventive step with respect to the teaching given in documents D2 and D3.

5. The subject matter of product claims 1 and 2 being novel and inventive, the same statement is true for independent claims 3 and 4 which relate to a method for producing the cold rolled steel sheet set out in claims 1 and 2. Besides, claims 3 and 4 have no longer been objected to by the appellant at the oral proceedings.

Order

For these reasons it is decided that:

The appeal is dismissed.

The Registrar: The Chairman:

V. Commare T. H. K. Kriner