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D E C I S I O N
of 11 October 2000

Case Number: T 0116/97 - 3.2.2

Application Number: 90121805.7

Publication Number: 0432498

IPC: C22C 38/12

Language of the proceedings: EN

Title of invention:

High tensile cold rolled steel sheet and high tensile hot dip galvanized steel sheet having improved stretch flanging property and process for producing same

Patentee:

KAWASAKI STEEL CORPORATION

Opponent:

Thyssen Stahl AG
Fried. Krupp AG Hoesch-Krupp

Headword:

-

Relevant legal provisions:

EPC Art. 52(1), 54, 56
EPC R. 57a

Keyword:

"Novelty (yes)"
"Inventive step (no) - main and auxiliary request 2"
"Admissibility of auxiliary requests 1 and 3 to 6 (no)"

Decisions cited:

-

Catchword:

-



Case Number: T 0116/97 - 3.2.2

D E C I S I O N
of the Technical Board of Appeal 3.2.2
of 11 October 2000

Appellant:
(Proprietor of the patent) KAWASAKI STEEL CORPORATION
No. 1-28, 1-Chome Kitahonmachi-Dori
Chuo-Ku
Kobe-City Hyogo 651 (JP)

Representative: Henkel, Feiler, Hänzel
Möhlstrasse 37
D-81675 München (DE)

Respondent:
(Opponent) Thyssen Stahl AG
Kaiser-Wilhelm-Strasse 100
D-47166 Duisburg (DE)

Representative: Werner, Dietrich H., Dr.-Ing.
Cohausz & Florack
Patentanwälte
Postfach 33 02 29
D-40435 Düsseldorf (DE)

(Opponent) Fried. Krupp AG Hoesch-Krupp
Postfach 10 22 52
D-45022 Essen (DE)

Representative: Werner, Dietrich H., Dr.-Ing.
Cohausz & Florack
Patentanwälte
Postfach 33 02 29
D-40435 Düsseldorf (DE)

Decision under appeal: Decision of the Opposition Division of the
European Patent Office posted 28 November 1996
revoking European patent No. 0 432 498 pursuant
to Article 102(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. The Appellant (patent proprietor: Kawasaki Steel Corporation) lodged an appeal against the decision of the opposition division to revoke European patent No. 0 432 498. The decision was dispatched on 28 November 1996.

The appeal and the fees for the appeal were received on 29 January 1997. The statement setting out the grounds of appeal were received on 8 April 1997.

The opposition was filed against the whole patent and was based on Article 100(a) EPC (lack of inventive step).

The opposition division had found that the subject-matter of claims 1, 2, 3 and 5 lacked novelty and that the subject-matter of claims 1 to 5 did not involve an inventive step.

The following prior art documents among those regarded as relevant by the opposition division have been taken into account as relevant documents during the appeal proceedings:

(1) H.T. Junius: "Beitrag zum kontinuierlichen Glühen von kaltgewalztem Feinblech aus Stahl" aus der Reihe Fortschritt - Berichte VDI, Reihe 2: Fertigungstechnik Nr. 140, (1987), VDI Verlag, pp. 1 to 6, 95, 111, 129, 131, 140-145.

(3) W. Bleck, H.T. Junius: "Annealing Process - Recovery, Recrystallization and Grain Growth", Editors: N. Hansen, D. Juul Jensen, T. Leffers, B. Ralph, published by Risø Nat. Laboratory, Denmark, (1986), pp. 229-234.

(4) K. Consemüller: "Entwicklung von Fein- und Feinstblechwerkstoffen für die Kaltumformung", Stahl und Eisen, 106, (1986), pp. 97-104.

(5) Technology of Continuously Annealed Cold-Rolled Sheet Steel, Proc. of a Symposium sponsored by the Heat Treatment and Ferrous Metallurgy Committees of the Metallurgical Society of AIME and held at the TMS-AIME Fall Meeting in Detroit, Michigan, Sept. 17-18, 1984, Ed. R. Pradhan, pp. 223-241.

II. Oral proceedings before the Board took place on 11 October 2000, at the end of which the requests of the parties were as follows:

The Appellant requested that the decision under appeal be set aside and that the patent be maintained as granted (main request) or that the patent be maintained in amended form according to the first auxiliary request submitted on 11 September 2000 or according to the second auxiliary request submitted at the oral proceedings or according to the third, the fourth, the fifth or the sixth auxiliary request submitted on 11 September 2000.

The Respondents (Opponents-Thyssen Stahl AG and F. Krupp AG Hoesch-Krupp) requested that the appeal be dismissed.

III. The independent claims of the Appellant's main request read as follows:

Main request

Claim 1

"A process for producing a high tensile cold rolled steel sheet improved in stretch flanging property,

comprising the steps of: preparing, as a material, steel containing 0.03% to 0.15% by weight of C, 0.05% or less by weight of Si, 0.5% to 1.2% by weight of Mn, 0.005% to 0.045% by weight of Nb, and 0.10% or less by weight of Al, the remainder being iron and unavoidable impurities; subjecting the material to hot rolling; effecting cold rolling at a reduction rate in thickness of more than 50%; and effecting annealing in which the material is heated at a heating rate of 5°C/sec or more and retained in a temperature range of 720 to 780°C for 20 to 60 seconds in a continuous annealing line, and then cooling the material."

Claim 2

"A high tensile cold rolled steel sheet, obtainable by the process of claim 1, having improved stretch flanging property, containing 0.03% to 0.15% by weight of C, 0.05% or less by weight of Si, 0.5% to 1.2% by weight of Mn, 0.005% to 0.045% by weight of Nb, and 0.10% or less by weight of Al, the remainder being iron and unavoidable impurities, and the steel sheet having a uniform and fine recrystallized ferrite structure having a mean grain diameter of 20 μm or less and an area fraction of 95% or more."

Claim 3

"A process for producing a high tensile hot dip galvanized steel sheet improved in stretch flanging property, comprising the steps of: preparing, as a material, steel containing 0.03% to 0.15% by weight of C, 0.05% or less by weight of Si, 0.5% to 1.2% by weight of Mn, 0.005% to 0.045% by weight of Nb, and 0.10% or less by weight of Al, the remainder being iron and unavoidable impurities; subjecting the material to hot rolling; effecting cold rolling at a reduction rate in thickness of more than 50%; and effecting annealing

in which the material is heated at a heating rate of 5°C/sec or more and retained in a temperature range of 720 to 780°C for 20 to 60 seconds in an in-line anneal type continuous hot dip galvanizing line, and then cooling and hot-dipping the material."

Dependent claim 4 reads as follows:

"A process as claimed in claim 3, wherein subsequent to the cooling step the material is hot-dipped."

First auxiliary request

The claims of this request correspond with the claims of the main request, except that the Si content is specified as being between 0.01% and 0.05%, and dependent claim 4 reads as follows:

"A process as claimed in claim 3, wherein subsequent to the hot-dipping step the material is galvanized."

Second auxiliary request

This request comprises claims 1 and 2 corresponding to claims 1 and 3 of the main request, and claim 3 which corresponds to claim 4 of the main request. In claims 1 and 2 the last feature "and then cooling the material" of the main request has been replaced by "and then rapid cooling at 20°C/sec or more in a temperature range of 700 to 500°C, in the cooling step subsequent to the annealing; the steel sheet having a uniform and fine recrystallized ferrite structure having a mean diameter of 20 μm or less and an area fraction of 95% or more."

Third auxiliary request

This request comprises claims 1 to 3 corresponding to claims 1 to 3 of the second auxiliary request, together with the limitation of the lower limit of Si content as in the first auxiliary request, and the following additional feature at the ends of claims 1 and 2:

"and a yield ratio of 70% or higher".

Fourth auxiliary request

This request comprises claims 1 to 3 corresponding to claims 1 to 3 of the second auxiliary request, together with the definition of the sulphur content of "0.005% or less by weight of S" in claims 1 and 2.

Fifth auxiliary request

This request comprises claims 1 to 3 corresponding to claims 1 to 3 of the fourth auxiliary request, together with a definition of the Si content as in the first auxiliary request, and the yield ratio as in the third auxiliary request, and the following additional feature at the ends of claims 1 and 2:

"and a side bend elongation of higher than 60%".

Sixth auxiliary request

This request comprises claims 1 to 3 corresponding to claims 1 to 3 of the fourth auxiliary request, together with an upper limit of the Nb content of 0.025%.

IV. The Appellant presented the following arguments:

Main request

Novelty

Document (5) disclosed different steels and corresponding processing steps, and therefore comprised different disclosures, respectively, which could not be combined to deny novelty. None of steels by itself anticipated the subject-matter of any of the claims. The Opposition Division had combined the different disclosures in an unallowable and ex post facto manner.

Inventive step

Document (5) was a study of the aging behaviour of steels and it was not relevant to the problem of tensile strength or ductility, which were the main problems of the patent in suit.

Moreover, this document was a general teaching, and it did not disclose a single steel having a composition according to the claims of the patent in suit, together with the treatment steps. This document was not a suitable starting point for the claimed invention, accordingly.

Furthermore, even following the teaching the document (5) would not result in the claimed process or steel. Only the steel having the composition given on page 224 was within the terms of claim 1, but it was subjected to a higher annealing temperature than claimed, as shown in Figure 1.

The composition of the steel used in the results of Figure 4 was not given and, moreover, this figure showed that if the Nb content were chosen to lie within

the claimed range, then an annealing temperature of about 820°C was necessary to achieve a recrystallisation greater than 95%, which was higher than that claimed. It was the combination of the claimed steel composition together with the annealing temperature range of 720°C to 780°C that led to the success of the invention, and this combination was not suggested in this or any other document.

Auxiliary requests

Amendments

Since claim 1 had been amended to meet the attack under Article 52(1) EPC, it was in order to amend claim 4 (first auxiliary request) for clarity. However, this claim would be cancelled in all the auxiliary requests were the Board to consider it unallowable.

Regarding the minimum Si content of 0.01%: In the context of the invention, Si was important for attaining a high tensile strength (see page 3, last two lines), and all the examples included steel with Si, the minimum amount being 0.01% as shown in Table 1, whose inclusion in the claims was justified, accordingly.

The range of S content, for example in auxiliary request 4, was supported by page 4, lines 32 to 35 and Example 7, and the upper limit of 0.25% of Nb in auxiliary request 6 was supported by the steel compositions C, M, and P in Table 1.

Inventive step

The combination of steel composition, the process steps, and rapid cooling, as defined in auxiliary request 2 gave rise to a good yield ratio, which teaching was not in the prior art.

- V. The Respondents presented the following arguments:

Main request

Novelty

Document (5) must be read as a whole, and its entire content may be considered in order to assess novelty. Since it disclosed all the features of claims 1 and 3, it anticipated the claimed processes. The process would automatically produce the grain size and area fraction as defined in claim 2, whose subject-matter, therefore, was also not novel.

Inventive step

The steels discussed in document (5) were also required to have a high tensile strength and ductility, and the composition given on page 224 overlapped with the composition in claim 1, and all the process steps of claim 1 were also disclosed on this page, except the annealing temperature. However, Figure 4 indicated that, in order to achieve a recrystallisation of > 95%, the annealing temperature must be selected to be around the claimed range if the Nb content was low, as in claim 1.

Auxiliary requests

Amendments

The claims as granted were already clear and there was no need to clarify them further, so that claim 4 of the first auxiliary request was inadmissible. The new limits of the Si, S and Nb contents in the auxiliary requests were all arbitrarily plucked from their proper context and this was not allowable under Article 123(2) EPC.

Inventive step

Rapid cooling of steel was a natural consequence of removing the steel from the oven on a conveyer band, and a cooling rate of 20°C or more was commonplace in the art as exemplified by document (4), Table 1, and document (1), page 129.

Reasons for the Decision

1. The appeal is admissible.

Main request

2. *Novelty*

A process or device lacks novelty only if all the features thereof are disclosed in a single embodiment or item of prior art, it is not sufficient that all the features be simply disclosed in a single document if they do not clearly belong in combination to a single embodiment or item of prior art. All the information contained in a document must form a coherent whole for it to be considered as a single item of prior art. In

document (5) all the features relating to a given steel composition and processing must, therefore, be clearly related to the same steel or its processing, for this steel to comprise a single item of prior art.

The document (5) was considered by the opposition division to be novelty destroying for claims 1, 2, 3, and 5. However, this document is a review article that summarises the work of different research groups reported in various publications to which reference is made. For example, page 224 describes industrial steels produced by USINOR, and pages 225 to 228 describe the results of a research projects reported in references 2 to 4, respectively, on page 239 (see page 225, the description of Figure 2), and these groups presumably worked on different steels.

This document, therefore, discloses different steels subjected to different processing steps, that are not clearly related, so each of them must be considered as a separate item of prior art. Of the various steels disclosed, no single steel has the composition and is subjected to the process steps defined in claim 1 of the patent in suit.

Thus, the steels produced by USINOR and described on page 224 of this document have the composition within the ranges given on this page and they undergo the treatment cycle described with reference to Figure 1 on the same page. Page 225 describes a steel which is different to the steels described on page 224 since its carbon content lies outside the range given on page 224, and is a steel studied in reference 2. The processes described with reference to Figures 2 to 5 on pages 225 to 228 apply to this steel only. Yet other steels, whose compositions lie outside the terms of claim 1, are described on page 229 in Table 1.

Thus, this document describes different steels with their respective processing parameters, and there is no evidence that a steel of a given composition may be subjected to other processing parameters. Document (5), therefore, describes different items of prior art, and not a single item of prior art as the respondent argues.

Moreover, none of the different items of prior art anticipates the process of claims 1 or 3 or the steels produced thereby and defined in claims 2 or 4 of the patent in suit, since at least the following features are lacking. The USINOR steels described on page 224 are not retained in a temperature range of 720 to 780°C for annealing, and the steels described on page 225 and in Table 1 do not possess the required composition.

Therefore, the subject-matter of the claims of the main request is novel.

3. *Inventive step*

3.1 The closest prior art is considered to be that item disclosed on page 224 of document (5) since this describes high-strength low-carbon steels microalloyed with niobium, for use in car body structural components, and having a chemical composition range that overlaps with the corresponding ranges defined in claim 1, viz. C = 0.06 - 0.09 wt%, Si = 0 wt%, Mn = 0.3 - 0.7 wt%, Nb = 0.03 - 0.08 wt%, Al = 0.03 - 0.06 wt%, and the remainder iron and unavoidable impurities.

The steels of page 224 are subjected to hot-rolling, cold rolling at a reduction rate of more than 50% (i.e. 65%), and continuous annealing under a thermal cycle typified by Figure 1. According to this figure, the material is heated at a heating rate of about 40°C/sec, and retained at the annealing temperature for

about 50 seconds, after which it is cooled. These process parameters, as defined in claim 1, would also appear to be normal in the art, and they are also disclosed in connection with the other steels of document (5) (see, for example, page 225, first paragraph and the description of Figure 2, and page 226, box inset in the upper right part of Figure 3).

- 3.2 The difference between the process of claim 1 and that described on page 224 of document (5) is that in the claimed process the steels are retained in a temperature range of between 720 and 780°C in the continuous annealing line.

The purpose of this temperature range is to promote recrystallisation so as to ensure satisfactory elongation and stretch flange properties, and to hinder grain growth, which degrades the hardness of the steel, as described on page 5, lines 3 to 6 of the patent.

Therefore, as the patent states on page 2, lines 7 to 9 and 47 to 50, the problem may be defined as the production of a cold rolled steel sheet and a hot dip galvanized steel sheet which are simultaneously required to have the somewhat contradictory properties of high tensile strength as well as high ductility.

- 3.3 In order to solve the above problem, the percentage of the second phase, e.g., pearlite is reduced, and a recrystallized ferrite structure consisting of uniformly fine grains is produced. Such a structure is obtained mainly by optimizing the annealing conditions so as to avoid grain growth.

3.4 However, this mechanism is well known to the person skilled in the art. This person knows that it is the grain structure that determines both tensile strength and ductility, and both of these properties may be optimised by controlling grain growth by selecting appropriate parameters of steel composition and thermo-mechanical treatment.

For example, document (5) discusses high-strength steels for car body structural components (see Introduction on page 224), where high ductility is an important requirement (see also page 238, first paragraph). In these steels, Nb is used to form carbonitrides, it being well known that niobium binds with carbon and nitrogen and precipitates them as carbonitrides during hot-rolling and in the subsequent annealing step, at the grain boundaries, as shown in Figure 8 of this document, which then inhibits grain growth. This is described on page 227 and the latter part of page 233.

The person skilled in the art, knowing the above mechanisms, and having the present aim in mind, that of providing a steel with uniformly fine grains, would be led by document (5) to the process of claim 1 of the patent in suit as an obvious process. This person would not just take the literal disclosure of this document and be bound by the actual parameters disclosed therein, rather he would learn from this document how certain properties of steel tend to vary within certain ranges of parameters, these tendencies being summarised in the figures. Guided by the tendencies disclosed in document (5) he would experiment with the parameters to achieve optimum properties.

Figure 4 of document (5) shows that the lower the Nb content the lower is the temperature required for annealing to achieve > 95% recrystallisation. Given

this teaching the person skilled in the art would experiment in order to achieve optimal parameters for a given steel, and select the best temperature accordingly. Figure 4 points to a temperature around the claimed temperature for the given Nb concentration.

Therefore, the process of claim 1 employs known principles for producing known results, the actual parameters used being a matter of routine experimentation. The process of claim 1 does not involve an inventive step, accordingly.

- 3.5 Carrying out the process of claim 1 automatically results in the grain size and area fraction as defined in claims 2 or 5. These parameters would also automatically result by carrying out the process described by the item of prior art on page 224 of document (5), for example, and do not involve an inventive step. The step of hot dip galvanizing is conventional in the art (see, for example, the summary of document (5)) and cannot bestow an inventive step on the claimed subject-matter, whether it is the final step or is followed by galvannealing.

Therefore, none of claims 2 to 5 involves an inventive step.

Auxiliary requests

4. *Amendments*

- 4.1 The appellant's arguments regarding the minimum Si content of 0.01% are not accepted since the description nowhere indicates that a minimal amount of Si is essential for the invention. On the contrary, the opening parts of the description state that although Si is good for increasing tensile strength, it deteriorates surface and other properties, (see page 2,

lines 21 to 24 and page 4, lines 1 to 3). Accordingly, "The present invention eliminates the need for the admixture of Si which deteriorates the surface properties and the effectiveness of hot dipping" (page 2, lines 47 and 48), which indicates that Si should be removed as much as possible. There is no support for the necessity of a certain minimum amount of Si.

Taking the lower limit of Si from Table 1 into claim 1 is taking it out of the context of the specific steel compositions given in the table, and also the processing conditions given in Table 2, which is not justified under Article 123(2) EPC. Therefore, the first auxiliary request is not allowable.

4.2 The third and fifth auxiliary requests also contain the above limitation of the Si content and are equally unallowable. The fifth auxiliary request is further objectionable in that the feature "side bend elongation of higher than 60%" has also been taken out of a particular context and generalised in an unallowable manner (see also point 4.3 below).

4.3 Similarly, auxiliary requests 4 and 6 are objectionable under Article 123(2) EPC owing to the limitation of the S content defined therein. Although Example 7 does list steels having a composition according to claim 1 of the patent as granted, and these steels have a maximum S content of 0.005%, this was disclosed only in the particular context of the given steel compositions and the processing conditions given in Example 7. Nowhere does the patent state that 0.005% was an absolute upper limit of the S content. The same considerations apply to the side bend elongation of 60%.

4.4 The second auxiliary request is free of any of the above objections. The main claims of this request contain the additional process step of rapid cooling at 20°C/sec or more in a temperature range of 700 to 500°C, in the cooling step subsequent to the annealing, and the feature that the steel sheet has a uniform and fine crystallized ferrite structure having a mean diameter of 20 μm or less and an area fraction of 95% or more.

These features are supported by page 5, lines 14 to 18 and claim 2, for example, and are allowable, accordingly.

4.5 Inventive step (second auxiliary request)

As the respondents have pointed out, a cooling rate of 20°C or more in a temperature range of 700 to 500°C is commonplace in the art. In fact there was good reason in the prior art for having such a cooling rate.

The steel used in the patent in suit is known generally as HSLA (high strength low alloy) steel microalloyed with Nb or Ti (see document (3) page 230) and document (4) describes the use of such steels for car body parts (page 98, right column, second complete paragraph) since they have suitable strength and anisotropy values. These steels are normally supplied in the cold-rolled and crystallisation annealed fine-grain condition and are provided with anti-corrosion surface protection layers. Table 1 of document (4) indicates that for such steels the recrystallisation range is between 610 and 670°C in the case of continuous annealing. This means that unwanted grain growth occurs in this temperature range, which grain growth is to be avoided, as explained above (point 3.4). Grain growth is a time-dependent phenomenon, so the steel should not linger in this temperature range, i.e. it should be

cooled rapidly through it. The exact temperature range through which rapid cooling is to occur will depend on the particular steel used, but this feature is simply the application of a known principle and not inventive, accordingly.

The latter feature of claim 1, in point 4.4 above, is also devoid of inventive step for the reason given in point 3.5 above.


4.6 For these reasons claims 1 and 2 of the second auxiliary request are not considered to involve an inventive step.

Order

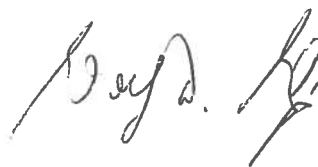
For these reasons it is decided that:

The appeal is dismissed.

The Registrar:


V. Commare

The Chairman:


W. D. Weiß

