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D E C I S I O N
of 15 October 2002

Case Number: T 0105/99 - 3.2.2.

Application Number: 91119058.5

Publication Number: 0484960

IPC: C21D 8/04

Language of the proceedings: EN

Title of invention:
Cold-rolled steel strip having excellent combined press formability and method of producing same

Patentee:
NIPPON STEEL CORPORATION

Opponent:
Thyssen Stahl AG

Headword:
-

Relevant legal provisions:
EPC Art. 54, 56

Keyword:
"Novelty and inventive step (yes)"

Decisions cited:
-

Catchword:
-

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Case Number: T 0105/99 - 3.2.2

D E C I S I O N
of the Technical Board of Appeal 3.2.2
of 15 October 2002

Appellant: (Opponent)
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Decision under appeal: Interlocutory decision of the Opposition Division of the European Patent Office posted 26 November 1998 concerning maintenance of European patent No. 0 484 960 in amended form.

Composition of the Board:

Chairman: W. D. Weiß
Members: M. G. Noël
U. J. Tronser

Summary of Facts and Submissions

I. The appellant (opponent), on 26 January 1999, lodged an appeal against the interlocutory decision of the Opposition Division, dated 26 November 1998, stipulating the amended form in which the European patent No. 0 484 960 could be maintained. The appeal fee was paid on the same day.

On 5 June 1999, the appellant filed a statement of the grounds for appeal together with a letter in which he requested to be re-established into the legal time limit for filing such statement of grounds. The respective fee was paid on the same day.

II. One opposition had been filed against the patent in its entirety and based on the grounds according to Article 100(a) EPC that the subject-matter of the product and the method claims lacked novelty or an inventive step, respectively.

The Opposition Division held that the subject-matter of the amended method claim 1 and product claim 3 according to the main request, submitted at the oral proceedings before the Opposition Division, were novel and involved an inventive step with respect to the documents

E1 Fudaba, K., Akisue, Y. and Tokunaga, Y., "The production of IF sheet steels for continuous annealing", Hirohata and Nagoya Works, Nippon Steel Corp., Japan; Proceedings of the 27th Annual Conference of Metallurgists, 28 to 31 August 1988, Montreal, Quebec, Canada, pages 290 to 303; and

E2 Masato Yamada and Yoshikuni Tokunaga, "Effects of Nb and Ti addition on the mechanical properties of extra low carbon cold-rolled steel sheet (development of Nb and Ti added extra low carbon steel sheet - II), Nagoya R&D Lab., Central R&D Bureau and Nagoya Works, Nippon Steel Corp., Transactions ISIJ, Vol. 25, 1985, presented at the 109th ISIJ Meeting, April 1985 Lecture No. S640.

With its grounds for appeal, the appellant cited for the first time document

E3 CAMP-ISIJ Vol. 3 (1990), p. 785, "Effect of Cooling on Grain Size of Hot Rolled Sheets in Ti Added Ultra Low C Steel".

On 17 September 2002, the appellant submitted a copy of a letter by the "VDEH Informationszentrum Stahl und Bibliothek" stating that document E3 had been received on 18 June 1990 by this institution.

III. On 31 January 2000, The Board issued a reasoned interlocutory decision ordering that "the appellant's request for re-establishment of rights is allowed and his statement of grounds of appeal filed on 5 June 1999 is to be treated as having been received in due time."

At the oral proceedings before the Board, which took place on 15 October 2002, the following final requests were submitted:

The appellant requested that the decision under appeal be set aside and that the patent be revoked in its entirety.

The respondent requested that the appeal be dismissed.

IV. The independent Claims 1 and 3 in the version underlying the decision under appeal read as follows:

"1. A method of producing a cold-rolled steel strip having excellent combined press formability, comprising the steps of:
providing a steel slab consisting, by weight, of not more than 0.0025% C, not more than 0.05% Si, not more than 0.30% Mn, not less than 0.007% but not more than 0.030% P, not more than 0.020% S, not more than 0.080% sol Al, not more than 0.0030% N, not less than 0.025% but not more than 0.120% Ti, not less than 0.003% but not more than 0.020% Nb, not more than 0.0002% B, and the balance Fe and incidental impurities; heating said steel slab and finishing hot-finishing-rolling at temperatures of 880 to 940°C to form a hot-rolled strip; subsequently starting cooling of said steel strip down to at least 850°C within 1.5 sec from the end of said hot finishing rolling so as to cool said steel strip at a rate of 50 to 200°C/sec, and coiling said hot-rolled steel strip at temperatures of 720 to 770°C;
subsequently cold-rolling said steel strip at a rolling rate of not less than 70%; and
subsequently recrystallization-annealing said cold-rolled steel strip at temperatures of 750 to 900°C by continuous annealing,
said cold-rolled steel strip having tensile strength in 45° direction (expressed as TS_{45}) of 28.5 to 31.0 kgf/mm^2 and r value in 45° direction (expressed as r45) of not less than 1.90.

3. A cold-rolled steel strip having excellent combined press formability, consisting, by weight, of not more than 0.0025% C, not more than 0.05% Si, not more than 0.30% Mn, not less than 0.007% but not more than 0.030% P, not more than 0.020% S, not more than 0.080% sol Al, not more than 0.0030% N, not less than 0.025% but not more than 0.120% Ti, not less than 0.003% but not more

than 0.020% Nb, not more than 0.0002% B, and the balance Fe and incidental impurities, said steel strip having tensile strength in 45° direction (expressed as TS_{45}) of 28.5 to 31.0 kgf/mm^2 and r value in 45° direction (expressed as r_{45}) of not less than 1.90, said cold-rolled steel strip being producible with the method according to Claim 1 or 2."

V. The appellant argued as follows:

The subject-matter of the product claim 3 was not novel having regard to the Super-EDDQ sample specified in line 2 of Table 2 on page 296 of document E1. Since this document was silent about the orientation chosen for the measurement of the T.S. value, a person skilled in the art would imply that the test sample had been oriented at 90° with respect to the rolling direction. The T.S. value being known to have its maximum in the rolling direction and its minimum transverse thereto, the value measured in 45° direction was known to be less than 1 kgf/mm^2. Therefore the Super-EDDQ material disclosed in Table 2 of E1 was identical to the product claimed in Claim 3.

The assumption that the method claim 1 contained a complete teaching to carry out the invention implied that, in Claim 1, the method features when applied to the specified steel composition necessarily resulted in the mechanical characteristics. Having this fact in mind, three lines of arguments guided a skilled person to the invention in an obvious manner.

(i) Starting from document E3 as the closest prior art, the subject-matter of Claim 1 differed therefrom by an additional content of Nb and by higher r-values. The technical problem to be solved would be to aim at higher r-values and to improve the combined press formability of this

material. A person skilled in the art would find the solution to this problem on pages 295 and 296 of document E1.

(ii) The same result would be achieved, if starting from document E3, the solution to the same problem was taken from document E2.

(iii) Also document E2 was qualified as closest prior art, because it disclosed steels of identical composition which were subjected to a treatment from which the one claimed in Claim 1 only differed by specifying the cooling rate from the temperature of the hot finishing rolling to the coiling temperature. Starting from the obvious technical problem of improving the combined press formability, a person skilled in the art would inevitably find the solution in document E3 and refine the grain structure by controlled cooling from the hot finishing rolling temperature to the coiling temperature.

VI. The respondent argued as follows:

The document E1 originated from the research center of the proprietor (respondent). Therefore it was assured that, unless explicitly stated, T.S. values stated in publications of this research center were determined in the rolling direction, as prescribed in the Japanese standard, and neither in 45°, as asserted by the appellant in its grounds for opposition, nor in 90° thereto as alleged later.

Therefore, the narrow range for the TS_{45} value had to be seen as a clearly different teaching which was not addressed in the cited prior art nor accidentally achieved therein. Moreover it had to be considered that, even though not mentioned, Boron in amounts of at

least 3 ppm is added to steels of the type in question to prevent grain boundary fraction (see document E1, Figure 11). Consequently, the low upper limit for the Boron content according to the patent in suit had to be considered as a difference over the prior art.

It was not correct to interpret Claim 1 such that the achievement of the mechanical parameters indicated therein was the automatic consequence of the ranges for the composition and for the method parameters. On the contrary, the composition and the method parameters must be correlated within these ranges such that the mechanical parameters meet their requirements, in particular the narrow range for TS_{45}. The detailed description in the patent of the influence which every single alloying and procedural measure has on the characteristics of the final product puts the person skilled in the art in the position to carry out the invention.

The metallurgical function of added Nb in the steel described in document E2 was quite different from that in the steel disclosed in the patent in suit, according to which a sufficient amount of Ti was added to stabilize both C and N in the steel. C and N such being already bound, the additionally added Nb remained in solid solution in the steel. Document E2, on the contrary, taught to add both Ti and Nb to stabilize N and C by precipitating TiN and NbC and to, therefore, add in an atomic ratio of 1 for Ti/N and Nb/C. Consequently, document E2 did not intend to maintain Nb in solid solution.

According to document E3 Ti was added in an amount sufficient to precipitate TiN and TiC, and the grain size of the hot-rolled steel was refined by a cooling process after the hot rolling. Not any reason could be seen why E3 should be combined with E2.

Only Chapter 2 on pages 295 and 296 of document E1 dealt with the specific problem underlying the patent in suit, namely to provide a steel sheet with improved combined press formability which was needed to form a rectangular shell like a deep oil pan. Only one of the exemplary steel compositions suggested in Table 2 for this particular application fell numerically under the compositional ranges of the patent in suit. Although not mentioned there, it had, however be assumed that this steel contained the usual amount of at least 0.0003% Boron to avoid secondary cracking (see document E1, Figure 11). This document was, however, completely silent about the method of manufacturing this steel sheet.

Reasons for the Decision

1. By its Interlocutory Decision of 31 January 2000 the Board found that "the appellant's request for re-establishment of rights is allowed and that his statement of grounds of appeal filed on 5 June 1999 is to be treated as having been received in due time". Since it also meets the other requirements of Articles 106 to 108 and Rules 84 and 85 EPC, the appeal is admissible.

2. Formal aspects have not been raised by the appellant and the Board sees no cause to revisit these issues on its own motion.

3. The Board acknowledges as proven that document E3 has been accessible to the public at the "VDEh-Informationszentrum Stahl und Bibliothek" in Düsseldorf as from 18 June 1990 (see letter of 17 September 2002). This document is therefore part of the state of the art. This fact has no longer been questioned by the respondent.

4. *The Invention*

Low carbon interstitial-free (IF) steels containing Ti and eventually also Nb have been developed for producing cold rolled steel sheets having an excellent deep drawability in particular for the automobile industry. Ti and eventually Nb fix the carbon and nitrogen in the hot-rolled sheet, so that recrystallization of the cold-rolled sheet proceeds in the practical absence of carbon and nitrogen in solid solution. In particular as far as automobile industry is concerned, it becomes evident that the various press formed parts used in the construction of an automobile call for different combinations of material characteristics, e.g. bearing parts of the car body with smoothly changing contours will put a higher emphasis on mechanical strength and less on the formability of the material whereas parts with a more complicated shape, like rectangular deep oil pans which have a deep drawn portion, a stretched portion and draw bead, put more emphasis on the formability of the material than on its mechanical strength.

As a consequence the IF steels have become a frame in the limits of which the materials for the various applications are tailor-made by modifying its composition and/or grain structure. Document E1 is reviewing this development.

The invention underlying the patent in suit is concerned with the development of a sheet material for parts, like the wheel house inner or a deep oil pan, which have a deep-drawn portion, a stretched portion and a draw bead and therefore require a so-called combined press formability to avoid excessive discard of the final product.

The invention achieves this goal principally by suggesting an IF-steel composition containing Titanium in an amount sufficient to precipitate the Nitrogen and Carbon as TiN and TiC (see EP-B-0 484 960, page 5, lines 5 to 7, and lines 25 and 26) and in addition containing a certain amount of solved Niobium which helps to control the recrystallization temperature (see page 5, lines 8 to 11). By choosing hot rolling finishing temperature adequately in the range of 880 to 940 °C and rapidly cooling the steel strip to at least 850 °C excessive recrystallization is avoided (see page 5, lines 22 to 24, and lines 35 to 38). Coiling of the hot rolled steel strip at a temperature adequately chosen in the range of 720 to 770 °C warrants a coarse structure of the TiC precipitate (see page 5, lines 25 to 34).

The teaching of the patent is based on the recognition that, in addition to a minimum value of r_{45}, the TS_{45} value is an indicator for the combined press formability which is claimed as being "excellent" when it is controlled to be in the range of 28.5 to 31.0 kgf/mm^2. Consequently, it is clear from the context of the patent in suit, that the r_{45} and TS_{45} values are not an obligatory consequence of the other features in Claim 1, and therefore redundant, but that the compositional and process parameters have to be chosen adequately within their respective ranges such that these values are attained.

5. *Novelty*

The appellant has maintained its allegation that the steel sheet material stated in the second line of Table 2 on page 296 of document E1 is detrimental to the novelty of the product Claim 3, because the T.S. value of 29 stated therein has to be implied as being measured transverse to the rolling direction which value was only less than 1 kgf/mm^2 lower than the one measured under 45° thereto. The opposition division, in the decision under appeal, found that the opponent failed to substantiate his allegation with any evidence.

During the appeal proceedings, the appellant still has not delivered any evidence to disprove the reiterated declaration of the respondent that in document E1, originating from the Japanese proprietor, T.S. values, following Japanese standards, were measured in rolling direction.

Consequently, the Board has no reason to deviate from the finding of the opposition division that the subject-matter of the product claim 3 is novel by virtue of the TS_{45} value lying in the range of 28.5 to 31.0 kgf/mm^2.

6. *Inventive step*

6.1 Only document E1, of the documents cited by the appellant, in its chapter (2) on pages 295 and 296 deals with the problem of press forming complicated parts like a deep oil pan, which involves the deep drawing of a rectangular shell. In forming the rectangular shape of a deep oil pan also combined press formability in the meaning of the invention is required (see patent in suit page 3, lines 22 to 30). In document E1, a good combined press formability in said

to be represented by a high r_{45} value, and it is suggested to use IF steel sheets manufactured by adding 0.007 niobium and about 0.05 titanium for this purpose, i.e. just the type of steel claimed by the patent in suit, which contains enough titanium to precipitate all the nitrogen and carbon as carbonitrides and to leave the niobium solved in the lattice structure. In the second line of Table 2, there is specified an exemplary composition which, apart from the fact that it is silent about its boron content, falls completely and undisputedly under the composition specified in Claims 1 and 3 of the patent in suit. Although the Board has some sympathy for the argument of the respondent that this silence implies the presence of boron in the usual amounts of at least 2 ppm to prevent grain-boundary fracture (see E1, pages 297/8, Figure 11), the said composition in Table 2, for the sake of argument, should be taken at face value to specify a complete analysis. This steel sheet is reported to have a r_{45} value of 2.14.

Then the subject-matter of claim 1 differs from this state of the art represented by Chapter (2) on pages 295/6 of document E1 by all its method steps and the range claimed for the TS_{45} value.

The subject-matter of product claim 3 differs from this state of the art by the range of the TS_{45} value alone.

6.2 Starting from this state of the art, the technical problem to be solved persists in (further) improving the combined press formability of these known steel sheets, which were produced by a non specified method, and to reduce the press defective percentage of the sophisticated parts produced therefrom.

6.3 In the product aspect of claim 3 the solution consists in the recognition that it does not suffice to increase the r_{45} value as much as possible but also to aim at a TS_{45} value lying in the narrow range of 28.5 to 31.0 kgf/mm^2. In the method aspect of claim 1 a combination of steps is specified which support the achievement of the values aimed at.

6.4 None of the documents cited by the appellant discloses that the TS_{45} value, in addition to the composition features and the minimum r_{45} value specified in claim 3, is representative for a low press defective percentage during manufacture of complicated parts, when the TS_{45} value is controlled to lie in the narrow range of 28.5 to 31 kgf/mm^2.

6.5 Document E2 discloses a type of IF steels which is metallurgically different from the steel composition used according to the patent in suit and that of the closest prior art. As is evident from Table 1 of this document, Ti and Nb are tested as equivalent for the precipitation of nitrogen and carbon insofar as the content of Ti is reduced to the extent the content of Nb is increased; it is only the sum of the Ti and Nb contents that counts. No freely soluble Nb is aimed at.

Even when, to follow the suggestion of the appellant for the sake of argument, the same method as disclosed the other type of IF steel sheet was applied to the composition of the said composition disclosed in document E1, the quenching conditions from the hot finishing rolling temperature to the coiling temperature would not yet be anticipated. Moreover, document E2 suggests 720°C as the highest coiling temperature, which, together with the missing TS_{45} feature, leads further away from the method used according to claim 1, which uses higher coiling temperatures in the range of 720 to 770°C.

Document E3 refers to the treatment of IF steel containing only Ti and no Nb and discloses that the grain size of the hot rolled strip becomes finer and less dependent from the hot finishing rolling temperature when quenched to a coiling temperature of 720°C in a manner similar to that applied according to Claim 1. It is stated that the r-value of the final product is increased, when the grain size is finer. No technical teaching to the solution of the complex problem underlying the patent in suit and aiming at achieving particular combination of TS_{45} and r_{45} values is given.

As is documented by the examples given in the solution to the complex problem underlying the invention is extremely sensitive to even minor deviations from the composition as well as from the method features specified in Claim 1, which have always to be controlled aiming at the narrow range for the TS_{45} value and maintaining the minimum for the r_{45} value.

Documents E2 and E3 specify single features of the invention but in a different context and do not contain any hint to the problem underlying the patent in suit. They have been found and cited knowing the claimed solution.

A combination of documents E2 and E3 cannot lead to the invention because of the metallurgical difference of the steel compositions used in either of them.

6.6 The subject-matter of the independent claims 1 and 3, therefore, involves an inventive step.

7. In view of the above, taking into consideration the amendments made by the proprietor of the patent before the opposition division, the patent and the invention to which it relates meet the requirements of the Convention.

Order

For these reasons it is decided that:

The appeal is dismissed.

The Registrar: The Chairman:

V. Commare W. D. Weiß