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File Number: T 405/90 - 3.2.2  
Application No.: 82 108 598.2  
Publication No.: 0 075 292  
Title of invention: Method for producing a cold rolled steel sheet

Classification: C21D 8/04, C22C 38/00

D E C I S I O N  
of 30 March 1993

Proprietor: Nippon Steel Corporation

Opponent: Thyssen Stahl AG

Headword:

EPC Articles 54(1) and 56

Keyword: "Novelty - main and first auxiliary requests (no)"  
"Inventive step - second auxiliary request (yes)"



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Boards of Appeal

Chambres de recours

Case Number : T 405/90 - 3.2.2

**D E C I S I O N**  
**of the Technical Board of Appeal 3.2.2**  
**of 30 March 1993**

**Appellant :**  
(Opponent)

Thyssen Stahl AG  
August-Thyssen-Str. 100  
W - 4100 Duisburg (DE)

**Representative :**

Werner, Dietrich H.  
Cohausz & Florack  
Schumannstraße 97  
W - 4000 Düsseldorf 1 (DE)

**Respondent :**  
(Proprietor of the patent)

Nippon Steel Corporation  
6-3, 2-chome, Ote-machi  
Chiyoda-ku  
Tokyo 100 (JP)

**Representative :**

Vossius & Partner  
Siebertstraße 4  
PO BOX 86 07 67  
W - 8000 München 86 (DE)

**Decision under appeal :**

**Decision of the Opposition Division 2.1.06.016 of  
the European Patent Office delivered on  
18 January 1990 and posted on 21 March 1990  
rejecting the opposition filed against European  
patent No. 0 075 292 pursuant to Article 102(2)  
EPC.**

**Composition of the Board :**

**Chairman :** G.S.A. Szabo  
**Members :** W.D. Weiß  
G. Davies

## Summary of Facts and Submissions

- I. European patent No. 0 075 292 was granted with effect from 11 June 1986 on the basis of European patent application 82 108 598.2, filed 17 September 1982. Claim 1 of the granted patent reads as follows:

"Method for producing a cold rolled steel sheet having an excellent press formability which comprises the steps of providing an aluminum killed steel containing not more than 0.07% C by weight, more than 0.10% to not more than 0.40% Mn by weight, 0.010 - 0.050% Al by weight, nitrogen and phosphorus, and optionally not more than 0.02% Si by weight, not more than 0.10 Cr by weight, not more than 0.10% Ti by weight, not more than 0.10% Nb by weight and not more than 0.0030% B by weight, the remainder being Fe and unavoidable impurities, hot rolling said steel at a temperature of not less than 850°C, cold rolling said hot rolled steel at a reduction of not less than 50%, and finally subjecting said cold rolled steel to a recrystallisation continuous annealing treatment at a temperature between the recrystallisation temperature and the A<sub>3</sub> point for a period of not longer than five minutes, characterized in that the said steel contains not more than 0.0025% N by weight, and not more than 0.010% P by weight, with the relation between P and N being  $P+N \leq 0.0175\%$ ."

- II. An opposition was filed against the patent on the ground of lack of inventive step (Article 100(a) EPC).

The following documents were cited in this respect:

- (D1) US-A-4 040 873;
- (D2) DE-A-2 109 431;
- (D3) DE-A-2 108 788;

- (D4) US-A-3 988 174; and
- (D5) DE-A-2 818 215.

III. According to the decision of the Opposition Division, delivered orally on 18 January 1990 and posted on 21 March 1990, the opposition was rejected.

The Opposition Division considered document (D2) to be the closest prior art and rated the subject-matter of Claim 1 of the patent in suit as a non arbitrary selection from its disclosure. Moreover, it could not see that any documents in this case, including document (D1), presented an incentive to the skilled person to select the phosphorous and nitrogen contents according to the characterising part of Claim 1.

IV. On 18 May 1990, the Appellant (Opponent) filed an appeal against this decision and paid the appeal fee on the same date. The Statement of Grounds was filed on 13 July 1990.

The Board drew the attention of the parties to the fact that, when assessing the disclosure of document (D1), an unavoidable non-soluble part of about 0.01% by weight had to be added to the acid soluble part of the aluminium content mentioned in this document before comparing these figures with the respective feature of the patent in suit. It was pointed out that document (D1) had to be considered as the closest prior art with respect to the subject-matter of the contested patent in its granted version and that this might even put its novelty into question.

V. The Appellant, in its written Statement of Grounds as well as during the oral proceedings of 30 March 1993, insisted on the view that document (D2) also disclosed all the features in the preamble of Claim 1 and additionally pointed to the fact that low contents of phosphorus and

nitrogen had a favourable influence on the ductility of the material. Therefore, the subject-matter of Claim 1, in its granted version, was a mere optimisation, which could not even create novelty with respect to document (D2). Moreover, page 14, first paragraph, of document (D1), when read together with page 16, second complete paragraph, suggested the selection of a low coiling temperature.

VI. The Respondent's arguments may be summarised as follows:

It was not true that document (D2) disclosed a total aluminium content of more than 0.009%. Since the alumina particles precipitating during the deoxidation migrated into the slag, the acid soluble part of the aluminium content was identical with the total aluminium content. Moreover, only a deoxidation by a combined addition of silicon and aluminium was disclosed, whereas according to the patent only aluminium was used for deoxidation and any deliberate addition of silicon was avoided.

Consequently, the subject-matter of the patent as granted differed from the disclosure of document (D1) not only in that the contents of phosphorus and nitrogen were generally reduced and in tune with each other but also in that the total aluminium content in the treated steel was lower. The aluminium content had to be maintained at a low level to avoid the formation of AlN which was known as a powerful grain growth inhibitor and, therefore, would have prevented the recrystallisation during the short period of a continuous anneal. The method according to the patent in suit permitted the application of a short-time continuous recrystallisation anneal in spite of a considerably higher aluminium content. The fact that, in the course of the method according to the patent in suit, lower coiling temperatures and higher degrees of cold reduction could be

used resulted in a more economic production of steel sheets for press forming purposes.

The possibly lower coiling temperature had, however, to be seen as an advantage rather than an obligatory feature.

Document (D2) had to be seen as a whole; the Appellant had relied on passages taken out of context. Although this document disclosed a continuous as well as a batch annealing for recrystallisation, its teaching was clear that batch annealing always had to be applied over periods of more than nine hours, when the final steel sheet should have a good press formability. The same applied to the coiling temperature, which, according to document (D2) had to be higher, when a more ductile product was called for.

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

VIII. The Respondent requested that the appeal be dismissed and that the patent be maintained as granted. On an auxiliary basis, he requested that the patent be maintained as amended on the basis of:

**first auxiliary request** - Claims 1 to 4 together with an amended description, submitted at the oral proceedings of 30 March 1993, and the Figures as granted;

or,

**second auxiliary request** - Claims 1 to 5 together with amended pages 2, 7, 8, and 9 of the description, submitted at the oral proceedings of 30 March 1993, with the rest of the description and all the Figures as granted.

Claim 1 of the first auxiliary request differs from the granted version in that the maximum values for the contents of phosphorus and nitrogen are reduced to the values indicated in the granted Claim 2.

Claim 1 of the second auxiliary request differs from the granted Claim 1 in that the feature "and wherein the coiling temperature of the hot rolled coil is not higher than 650°C" has been added at the end.

#### Reasons for the Decision

1. The appeal is admissible.
2. Amendments

The claims as granted are based on the original disclosure.

Claim 1 according to the first auxiliary request is based on Claims 1 and 2 as granted.

Claim 1 according to the second auxiliary request is based on Claim 1 as granted and on page 6, line 19; page 7, line 9; page 11, line 9 and page 15, line 20, of the original description which disclosure is contained in the identical form in the granted version of the description. It is true that the upper limit for the coiling temperature of 650°C there is always disclosed together with a lower limit of 575°C or 550°C, respectively. This disclosure, has, however, to be read with page 4, line 19 to page 5, line 6, and page 14, line 20 to page 15, line 16, of the original description, wherefrom the teaching can be extracted that a good press formability may even be expected when the actual coiling temperature is chosen in the lower region of the broad range of coiling temperatures used in practice.

Since these amendments also represent a reduction of the scope of protection, there is no objection to the current claims under Article 123 EPC.

3. State of the art and novelty

3.1 Document (D1) discloses a method for producing a cold rolled sheet having an excellent press formability (column 1, lines 1 to 12) which starts from normal low carbon steel (column 2, line 59 to column 3, line 4, and column 3, line 63 to column 4, line 9) containing 0.03 to 0.10% carbon, 0.10 to 0.60% manganese; 0.001 to 0.008% nitrogen, 0.04% or less phosphorus, 0.003% or less sulphur, and with particularly controlled contents of oxygen, silicon and acid soluble aluminium, the remainder being iron and the usual incidental impurities. If the actual composition of this known steel is selected from within the ranges as mentioned above, there is no obstacle to achieving the object of document (D1), which consists in providing an economic method (comprising a short time continuous recrystallisation annealing) for the production of a cold reduced steel strip with excellent press formability. In particular, smaller contents of phosphorus and sulphur should be chosen to improve ductility and a lower nitrogen content is preferred to improve strain aging property (column 4, lines 1 to 9 and column 5, lines 30 to 33).

The oxygen content has to be reduced in the steel to 0.02% or less (column 3, lines 5 to 31). In this context, also the chemically bound part of the oxygen is counted, because it is explicitly mentioned (column 3, lines 5 to 7): "Oxygen is known to exist in steel as oxide type fine inclusions with Fe, Mn, Si and Al." Anyone of the conventional methods, but preferably deoxidation with silicon and/or aluminium, may be used to reduce the oxygen

content (column 3, lines 20 to 31). In the case where silicon is used for deoxidation as above mentioned (column 3, lines 32 to 48), the preferred range for its content is set between 0.1% and 0.02%. That implies that the silicon content will be lower than 0.02% (namely in the amount usual for an impurity in low carbon steels), when aluminium alone is used as a deoxidation agent, which is an admissible option in the frame of document (D1) as stated above.

When aluminium, either alone or together with silicon, is used (column 3, lines 49 to 62) the deoxidation must be controlled in a way that the acid soluble part of the aluminium content [Sol.Al] in the steel after deoxidation is 0.009% or less, and preferably 0.005% or less. [Sol.Al] tends to form AlN precipitates which are known to act powerfully as grain growth inhibitors during a final recrystallisation anneal. A higher surplus of [Sol.Al] would have only a poor additional deoxidising effect but would increase the content of the more noxious AlN considerably.

- 3.2 Document (D1) teaches that the method disclosed therein produces a cold rolled steel sheet having an excellent press formability. There is no concern that this teaching would not work at the low nitrogen and phosphorous contents selected by the patent in suit. On the contrary, document (D1) (see column 4, first paragraph) states that a smaller [P] improves the ductility and a lower [N<sub>2</sub>] improves the strain aging property.

The Board does not share the view that according to document (D1) a certain amount of N is considered to be a favourable component in view of the over-ageing step (point 2.2 of the decision under appeal). On the contrary, the over-ageing step, in document (D1), is considered to

be necessary to precipitate those carbides and nitrides, which cannot be economically avoided during the production of the steel, in a form which is the least noxious for a low yield strength (document (D1), the paragraph bridging the columns 4 and 5).

3.3 It is true and generally known that most of the alumina formed during the deoxidation (killing) of a steel melt with aluminium migrates into the slag. But it is also generally known that a part of it remains in the steel in form of finely dispersed inclusions (document (D1), column 3, lines 5 and 6). The fact that the insoluble part of the aluminium which remains in the steel in this form cannot be reduced to a content of below about 0.01%, even when the melt is intensely rinsed in the ladle, belongs to the basic knowledge of the metallurgical engineer. When, according to the disclosure of document (D1), the option of deoxidation with aluminium is chosen, the total amount of aluminium in the steel will, therefore, lie in the range of about at least 0.01 to about at least 0.02%. This is the figure which has to be compared with the aluminium content of 0.010 to 0.050% of the patent in suit.

3.4 A slab of a steel with a composition described above is hot rolled with a finishing temperature of above 800°C (Claim 1; column 4, lines 15 to 17), for instance between 800 to 870°C (column 7, line 38). The hot rolled steel is cold rolled (Claim 1, column 4, line 50) with a reduction of for instance 60 to 84% (column 7, lines 39 to 41). The cold rolled steel strip is finally subjected to a recrystallisation continuous annealing treatment at a temperature within the range of 680°C to 900°C, hence between the recrystallisation temperature and the A3 point, for 30 to 180 seconds (Claim 1; column 7, lines 44 to 46, lines 53 to 55, and lines 64 to 66).

- 3.5 In view of the above considerations, the situation can be summarised as follows:

Whenever the method of the Claims 1 according to the main request as well as to the first auxiliary request is carried out starting from a steel with a total aluminium content of between about 0.01% and about 0.02% (EP-B-0 075 292, Table 2, Examples A, B, D, and H) and coiling at a temperature of 650°C to 800°C, it only executes the teaching of document (D1) and achieves a technical effect predicted by this document (good press formability, high ductility, decreased strain ageing).

The Respondent has submitted that the particular restricted and tuned selection of the phosphorus and nitrogen contents result in the advantages that higher aluminium contents and a coiling temperature which is lower than in document (D1) may be chosen and that, therefore, the subject-matter of Claim 1 should be rated as a patentable purposive selection. This argument is, however, irrelevant for the embodiments as described in the preceding paragraph, because in this case these advantages do not come into effect.

Consequently, the subject-matter of Claim 1 according to the main as well as the first auxiliary requests is not novel with respect to document (D1). These claims are, therefore, not allowable.

- 3.6 As regards Claim 1 according to the second auxiliary request, it is relevant that Document (D1) discloses coiling temperatures of 650°C to 800°C (column 4, lines 21 and 22; column 10, line 50). These general passages must, however, be read in conjunction with the description of the technical reasons (column 4, lines 24 to 31) saying that the desired rough carbide distribution only occurs

when the coiling temperature exceeds 650°C. Therefore, the coiling temperature should suitably be selected within the range of 650°C to 800°C.

Consequently, document (D1) discloses only coiling temperatures which are higher than 650°C.

- 3.7 The main concern of document (D2) is to avoid strain ageing and thus to condition a steel for a subsequent enamelling or covering with an aluminium layer. In the processes which lead to an enamelled product, the recrystallisation annealing is combined with the enamelling anneal, no press forming step following thereafter. The gist of document (D2) is that a certain amount of niobium unbound to carbon is provided which reduces the tendency to strain ageing during the final anneal. This unbound niobium obviously inhibits the recrystallisation thus prolonging the annealing time when total recrystallisation is required.

Contrary to the assertion of the Respondent, document (D2) does not disclose a steel composition free from niobium. The analysis mentioned on page 14, first paragraph, refers only to an intermediate stage of the steel melt before the addition of aluminium and niobium (page 14, last paragraph to page 15, first paragraph).

To effect recrystallisation, document (D2) (see page 23, Table III, pages 25 and 26, Table IV, page 28, line 12, page 40, Table VIII) discloses, therefore, annealing periods of up to 16 hours which cannot be done continuously. Only the longer periods of about nine hours (see pages 39 and 40) result in completely recrystallised structures exhibiting a combination of mechanical parameters which qualify the steel sheet for press forming.

Although continuous annealing is mentioned in this document (page 7 last paragraph) this never occurs in the frame of a method for producing a cold rolled steel sheet having an excellent press formability.

- 3.8 Document (D3) discloses a method for producing a low carbon steel sheet having a good press formability in which the cold rolled sheet is subjected to a long time batch annealing step.

Document (D4) concerns the production of a hot rolled steel sheet.

Document (D5) only concerns the treatment of an unkilld steel without any aluminium and does not disclose any value for the nitrogen content.

- 3.9 The subject-matter of Claim 1 according to the second auxiliary request is, therefore, novel.

4. Closest prior art and difference

Since the subject-matter of Claim 1, according to the main and first auxiliary requests, is not novel, only the second auxiliary request deserves further consideration.

In view of the detailed analysis given under points 3.1 to 3.5 above, the Board considers document (D1) to be the prior art which lies closest to the subject-matter of Claim 1 according to the second auxiliary request.

The characterising portion of Claim 1 according to the second auxiliary request contains the feature that the coiling temperature of the hot rolled coil is not higher than 650°C. Such a low coiling temperature is expressly

excluded by the disclosure of document (D1). Because the particular selection, namely, that the steel contains not more than 0.0025% N by weight, and not more than 0.010% P by weight, with the relation between P and N being  $P+N \leq 0.0175$  (which is not apt to create novelty in connection with coiling temperatures exceeding 650°C), is the prerequisite to enable coiling to be done at a temperature which is not higher than 650°C, these two features have to be rated as a combination forming the difference with respect to the closest prior art.

5. Problem and solution

Like the subject-matter of the patent in suit, the method according to document (D1) aims at producing a cold rolled steel sheet for press forming in as economic a manner as possible. Therefore, this known method also is controlled so as to enable the final annealing to be carried through continuously during a period in terms of minutes instead of using a batch annealing lasting nine hours or more.

However, in this known method, coiling after the hot rolling step has to be performed at temperatures exceeding 650°C in order to avoid creating a certain form of precipitation, which would result in an increased energy consumption during the cold rolling step and a reduced press formability of the final product. Due to this high coiling temperature, the cooling is non-uniform throughout the sheet. As a result, the uniformity of mechanical properties in the longitudinal direction as well as the width direction is lowered. Particularly, the quality of the top and bottom ends of the coil is seriously impaired so as to substantially reduce the yield of the steel product. In addition, a thick scale is produced by the high temperature coiling, with the disadvantage that the

descaling efficiency of the hot rolled steel strip is low (EP-B-0 075 292, page 2, lines 37 to 42).

Starting from document D1, the technical problem of the patent in suit therefore consists in providing a method for producing a cold rolled steel sheet having excellent stretchability, deep drawability, and an eminent secondary workability, which appears after the press working by a continuous process with high productivity, high yield and, low energy consumption, allowing a high cold rolling reduction (EP-B-0 075 292, page 2, lines 43 to 46).

This problem is solved according to the characterising part of Claim 1 of the second auxiliary request in that the nitrogen and phosphorus contents and the coiling temperature are adjusted as already explained.

6. Inventive step

The disclosure of document (D1) is unambiguous in teaching that the hot rolled strip has to be coiled at temperatures exceeding 650°C in order to avoid undesirable influences caused by carbide in steel. This feature is also expressly contained in Claim 1 of document (D1). There is no indication that the particular tuned selection of the phosphorous and nitrogen contents, according to the respective feature of the patent in suit, results in the extra effect of enabling the use of a coiling temperature which is not higher than 650°C.

According to the analysis under point 3.7. above, the disclosure of document (D2) is principally concerned with producing a steel sheet exhibiting improved strain ageing properties which are the prerequisite for a subsequent enamelling step. This known method comprises various embodiments and modifications including coiling at low and

high temperatures as well as the application of continuous and batch methods during the final annealing (page 6, last paragraph to page 8, first paragraph; page 17, first complete paragraph). The document is, however, also firm in teaching that coiling temperatures higher than 650°C and long time batch annealing have to be chosen whenever the steel sheet, in addition to excellent strain ageing properties, is required to have a combination of mechanical parameters which qualify for press forming (page 8, second paragraph; page 16, penultimate paragraph to page 17, first line; page 18, lines 7 to 17; page 23, Table III; pages 25 and 26, Table IV; page 28, line 12; pages 39 and 40).

Consequently, documents (D1) and (D2) lead away from the solution of the patent in suit as presented in the form of Claim 1 according to the second auxiliary request. The disclosure of documents (D3) to (D5) lies even farther away from the subject-matter of this claim and has never been used by the Appellant in support of its arguments during the appeal proceedings.

The Board, therefore, comes to the conclusion that the subject-matter of Claim 1 according to the second auxiliary request cannot be derived in an obvious manner from the documents cited by the Appellant and must accordingly be seen as involving an inventive step within the meaning of Article 52(1) in combination with Article 56 EPC.

7. The independent Claim 1, according to the second auxiliary request, together with dependent Claims 2 to 5, the revised description adapted thereto and the figures as granted can, therefore, may form the basis for maintaining the patent as amended.

**Order**

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


1. The decision under appeal is set aside.
  
2. The case is remitted to the first instance with the order to maintain the patent on the basis of the documents of the second auxiliary request which are specified in point VIII of the Facts and Submissions above.

**The Registrar:**



S. Fabiani

**The Chairman:**



G. Szabo