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D E C I S I O N
of 18 November 2002

Case Number: T 0470/98 - 3.2.2

Application Number: 88108798.5

Publication Number: 0295500

IPC: C21D 8/02

Language of the proceedings: EN

Title of invention:

Hot rolled steel sheet with a high strength and a distinguished formability

Patentee:

Nippon Steel Corporation

Opponent:

Corus UK Limited
Corus Staal BV

Headword:

-

Relevant legal provisions:

EPC Art. 52(1), 54, 56, 83, 122, 123(2)

Keyword:

"Novelty (yes)"
"Inventive step (yes)"
"Sufficiency (yes)"
"Re-establishment of rights (allowed)"

Decisions cited:

T 0201/83, T 0105/99

Catchword:

-



Case Number: T 0470/98 - 3.2.2

D E C I S I O N
of the Technical Board of Appeal 3.2.2
of 18 November 2002

Appellant:
(Opponent)

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Decision under appeal:

Interlocutory decision of the Opposition Division
of the European Patent Office posted 4 March 1998
concerning maintenance of European patent
No. 0 295 500 in amended form.

Composition of the Board:

Chairman: W. D. Weiß
Members: S. S. Chowdury
J. C. M. De Preter

Summary of Facts and Submissions

I. The appeals are against the interlocutory decision of the opposition division to maintain European patent No. 0 295 500 in amended form on the basis of the second auxiliary request. The decision was dispatched on 4 March 1998.

The opponents (Corus UK Ltd (OI) and Corus Staal BV (OII), hereinafter appellants O) filed appeals and appeal fees against the interlocutory decision on 12 May 1998 and 14 May 1998, respectively, and the grounds of appeal were filed on 10 July 1998 and 9 July 1998, respectively.

The patent proprietor, Nippon Steel Corporation (hereinafter appellant P) lodged its appeal on 14 July 1998, and on the same date paid the appeal fee and filed the grounds of appeal. At the same time it requested restitutio in integrum with respect to the time limit for filing an appeal against the Interlocutory Decision in the opposition proceedings and the respective fee.

The oppositions were filed against the whole patent and were based on:

- Article 100(a) EPC (lack of novelty and inventive step)
- Article 100(b) EPC, that the patent specification does not disclose the invention sufficiently clear and complete for it to be carried out by a person skilled in the art

- Article 100(c) EPC, that the subject-matter of the European patent extends beyond the content of the application as filed.

The opposition division had found that the requirement of sufficiency of disclosure was met satisfactorily and that the subject-matter of the European patent did not extend beyond the content of the application as filed. Moreover, the opposition division decided that the claimed subject-matter was novel, but that, starting from the document D1 as the closest prior art document, the subject-matter of claim 1 of the main request did not involve an inventive step, having regard also to document D28. The first auxiliary requests was not admissible since it was objectionable under Article 123(2) EPC. However, the second auxiliary request was considered to meet the requirements of the EPC.

The following documents were considered in the appeal procedure:

- D0: JP-A-60-43425 and its English translation.
- D1: Tetsu to Hagane, 1986, vol. 22, S-1384, O. Kawano et al
- D2: Trans. ISIJ, 1981 vol.21, pages 812 to 819, T. Furukawa et al., Technical Report
- D4: JP-A-60-184664 Abstract (English) and translation into English

- D8: N. Nagao et al., Hot rolled high strength steel sheet for automotive use produced by controlled cooling; Paper presented at the 1985 TMS-AIME Int. Conf. on Accelerated Cooling of Steel (Pittsburgh) edit. by P. D. Southwick, pages 463 to 479
- D28: O. Matsumura et al.,: Enhancement of Elongation by Retained Austenite in Intercritical Annealed 0.4C-1.5Si-0.8Mn Steel, Research Article, Trans. ISIJ, no. 7, vol. 27, July 1987, pages 570 to 579
- D29: Hot Rolling of Steel, William R. Roberts, 1983 New York
- D30: The Making, Shaping and Treating of Steel, William T. Lankford et al., 10th Edition, 1985, USA.

II. Requests

At the end of oral proceedings held on 18 November 2002 the appellants O requested that the proprietor's request for re-establishment of rights be refused and its appeal be rejected as not having been filed, further the decision under appeal be set aside and that the European patent be revoked.

The appellant P requested that its request for re-establishment of rights be allowed and its appeal be considered as filed in due time. It further requested that the decision under appeal be set aside and that the patent be maintained on the basis of claims 1 to 12 and page 4 of the description, all submitted at the oral proceedings, the rest of the description and as granted and the figures as granted.

III. Independent claims 1 and 2 and 4 and 5 of this request read as follows:

"1. A hot rolled steel sheet with a high strength and distinguished formability having a strength-ductility balance $TS \times T.El > 2416$ (TS = tensile strength in kgf/mm^2 ; T.El = total elongation in %) comprising (by weight) 0.15 to 0.21% C, 0.5 to 2.0% Si, 0.5 to 2.0% Mn with the balance being iron plus inevitable impurities and having a microstructure composed of ferrite, bainite and retained austenite phases with the ferrite phase being in the ratio (V_{pf}/d_{pf}) of 7 or more of polygonal ferrite volume fraction V_{pf} (%) to polygonal ferrite average grain size d_{pf} (μm) and the retained austenite phase being contained in an amount of 5% by volume or more on the basis of the total phases."

"2. A hot rolled steel sheet with a high strength and distinguished formability having a strength-ductility balance $TS \times T.El > 2416$ (TS = tensile strength in kgf/mm^2 ; T.El = total elongation in %) comprising (by weight) 0.15 to 0.4% C, 0.5 to 2.0% Si, 0.5 to 2.0% Mn and one of 0.0005 to 0.0100% Ca and 0.005 to 0.050% rare earth metal with S being limited to not more than 0.010% and the balance being iron plus inevitable impurities and having a microstructure composed of ferrite, bainite and retained austenite phases with the ferrite phase being in the ratio (V_{pf}/d_{pf}) of 7 or more of polygonal ferrite volume fraction V_{pf} (%) to polygonal ferrite average grain size d_{pf} (μm) and the retained austenite phase being contained in an amount of 5% by volume or more on the basis of the total phases."

"4. A process for producing a hot rolled steel sheet of claim 1, comprising the steps of subjecting the steel composition defined in claim 1 to a hot finish rolling with a total draft of at least 80% in such a manner that its rolling end temperature is at least $Ar_3 - 50^\circ C$, successively cooling down the steel to a desired temperature T within a temperature range from the lower

one of either the Ar_3 temperature or said rolling end temperature to Ar_1 at a cooling rate of less than 40°C/s , successively cooling the steel at a cooling rate of 40°C/s or more and coiling the steel at a temperature of more than 350°C to 500°C ."

"5. A process for producing a hot rolled steel sheet of claim 2, comprising the steps of subjecting the steel composition defined in claim 2 to a hot finish rolling with a total draft of at least 80% in such a manner that its rolling end temperature is at least $Ar_3 - 50^\circ\text{C}$, successively cooling down the steel to a desired temperature T within a temperature range from the lower one of either the Ar_3 temperature or said rolling end temperature to Ar_1 at a cooling rate of less than 40°C/s , successively cooling the steel at a cooling rate of 40°C/s or more and coiling the steel at a temperature of more than 350°C to 500°C ."

IV. The appellant P presented the following arguments:

It was clear that if the main or first auxiliary request would be refused by the opposition division, then the patent proprietor intended to file an appeal as may be concluded from the letter of 11 September 1997 of the patentee's European representative to the Japanese representative and from the brief of 29 December 1997 filed with the EPO.

However, when the decision under appeal was received on 5 March 1998 no deadlines were noted either in the date stamp provided on the cover sheet of the decision under appeal or in the deadline diaries. It was realised that the time limit for filing an appeal had been missed only when the file was handed over to the patentee's European representative after the receipt of the notification of the appeal of Opponent I on 19 May 1998. With respect to the incoming mail, any mail

delivered from official authorities like the EPO was separated from the remaining mail by office assistants and was transferred directly to the person in charge of calculating and noting any time limit. This was the task of Mrs R. Keller, a Patentanwaltsgehilfin, who joined the firm in 1972. After noting the time limits on the receipt stamp and in the central office diary, Mrs R. Keller then passed the official mail to Ms G. Stengert (who joined the firm in 1985) for noting the final and critical EPO deadlines in a separate diary (the other final deadlines being noted in a third diary under the supervision of the head of the administration and her assistant).

Hence, as highly qualified and reliable staff was employed, all due care required by the circumstances had been taken to observe any time limit vis-a-vis the EPO. However, it was unclear whether the decision under appeal had not been properly transferred to Mrs R. Keller or whether Mrs R. Keller and subsequently Ms G. Stengert overlooked or misinterpreted the decision under appeal. However, the failure to observe the time limit must be excused as an isolated procedural mistake in an otherwise completely reliable system (T 105/99).

The upper value of 0.21% for the carbon range was disclosed in Table 1 and was allowable according to T 201/83 since the carbon value was not closely related to the values of the other constituents. The intention of the patent proprietor was to claim a closed composition and the combination of the words "comprising" and "the balance being iron plus inevitable impurities" in the claims was intended to express this.

These parameters were, moreover, easy to measure as indicated in the patent at page 5, lines 10 to 12, and the method of testing TS was clearly the Japanese standard mentioned in D0 since the present invention started from and was an improvement on the steel of D0.

The parameters (V_{pf}) and (d_{pf}) were crucial to the invention and not arbitrary features. It was stressed throughout the patent that the microstructure of the steel must include a large number of small grains to ensure a high value of TSxT.E1. Therefore, the claimed steel was novel over the steel of D1 by virtue of the parameter (V_{pf}/d_{pf}) > 7. D1 described a process which did not exclude the presence of martensite and pearlite.

The opposition division combined the documents D1 and D28 to deny inventive step, but this was wrong since D28 described a cold rolled steel which had a quite difference microstructure to the present steel and also related to a high carbon steel. D28 had no relationship with the problem of the patent in suit, which was to produce a low carbon steel sheet having a large amount of retained austenite with no martensite phase and a high value of TSxT.E1 in the hot rolled condition.

- V. The appellants O were both represented by the same person at the oral proceedings, who relied largely on their written submissions during the opposition and appeal procedures. Their arguments may be summarised as follows:

It was clear that something had gone wrong in the office of the patentee's European representative after the receipt of the decision under appeal. This could happen but all the circumstances of the mistake should have been investigated immediately. However, the patentee had given information only in a piecemeal

manner. In particular, it was not explained where the decision under appeal was found on 19 May 1998. Moreover, no mail book was available in which all incoming mail was entered and there were blank parts in the right columns of Ms R. Keller's diary of 14 April and 14 July 1998. Furthermore, no pre-time warning was entered in the diaries for the request for re-establishment of rights and the grounds of appeal. Hence, the facts and arguments for the requested re-establishment of rights were not convincing.

It was accepted use of the English language that the term "comprising" referred to a non-exhaustive list, whereas "consisting of" referred to an exhaustive list so that closed compositions were normally defined using the term "consisting of". The use of "comprising" in the claims meant that other elements such as nickel, chromium, etc could be included in the claimed composition, which would prevent the invention from working, so that the claims were insufficient.

The patent failed to identify the testing methods used to measure the results and parameters claimed, so that the patent was insufficient for this reason also.

The upper value of 0.21% of the carbon range in claim 1 was taken from Table 1, but this value of carbon was disclosed only in connection with specific values of calcium and the other components of the steel as tabulated. Claim 1 was objectionable under Article 123(2) EPC, accordingly.

The value of $TS_{xT.E1} > 2416$ in claim 1 was merely a desideratum, and the parameter (V_{pf}/d_{pf}) of 7 or more was inevitably associated with steels of the type claimed and an irrelevant by-product of the other features of claim 1, particularly the volume fraction of retained austenite. It was not an independently controllable

feature that could be exploited by the person skilled in the art. According to the opponents' experience the (V_{pf}/d_{pf}) ratio had no effect on the TSxT.E1 product. This was, therefore, not really a distinguishing feature. Nor did the patent give any individual values for (V_{pf}) or (d_{pf}) such that they could be compared with the prior art, so the novelty of the subject-matter of claims 1 and 2 was questionable. This view was confirmed by the opposition division. The steel sheet of claim 1, therefore, lacked novelty.

If novelty were to be acknowledged then the subject-matter of claim 1 lacked inventive step.

D1 explicitly disclosed all the features of claim 1 except the (V_{pf}/d_{pf}) ratio, but this was implicitly disclosed, and in any case obvious. D2 stated that retained austenite appeared at both ferrite grain boundaries and within the ferrite grains, whose consequence was that the volume fraction of the ferrite should be increased and/or the diameter of the ferrite grains should be decreased. This would increase the (V_{pf}/d_{pf}) ratio.

Document D4 disclosed a steel with a composition overlapping the composition of claim 1, and mentioned a super-fine ferrite which, from the data given, would have a (V_{pf}/d_{pf}) ratio greater than 8 and a TSxT.E1 > 2416. Thus, this prior art steel with a closely related composition had the necessary TSxT.E1 value, the necessary microstructure, and the necessary (V_{pf}/d_{pf}) ratio, and also rendered the claimed steel obvious.

The feature $(V_{pf}/d_{pf}) > 7$ was obvious in view of D28 which discussed the formation of retained austenite and said that this appeared both at the ferrite grain boundaries and within the ferrite grains. Retained austenite was stated to be less than 2µm in diameter,

whose consequence was that in order to obtain large proportions of retained ferrite as instructed in D1, the ratio (V_{pf}/d_{pf}) would be increased to over 7.

Claim 2 differed from claim 1 merely by the inclusion of calcium or rare earth elements, and a limitation of the sulphur content, the use of each of which for the stated purpose of controlling sulphide inclusions was routine practice, and this claim was also not patentable.

Figure 1 of D1 clearly showed all the process steps of claim 4. The similarity of this figure with Figure 6 of the patent and the identity of authorship suggested that all the process of claim 4 was disclosed in D1. D1 also rendered the process of claim 5 lacking in inventive step. A total draft of at least 80% was commonplace in the production of hot rolled steel, as proved by D29 and D30. The considerations for coiling temperatures in relation to retained austenite were also well known, as exemplified by D0, D1, and D4, and D8 disclosed a hot rolling and cooling programme for a similar steel. For these reasons the claimed methods were also obvious.

Reasons for the Decision

1. The appeals of the appellants O are admissible.
2. *The appeal of the appellant P - re-establishment of rights.*
 - 2.1 When the appeal of Opponent I was notified on 19 May 1998 the patentee's European representative realised that the time limit for filing an appeal had been missed. As the request for the re-establishment of rights stating the grounds on which it is based was

filed on 14 May 1998 with the simultaneous payment of the appropriate fee and as the omitted act was filed on the same date, the request for re-establishment of rights is admissible (Article 122(2) and (3) EPC).

2.2 As stated under V supra, the opponents contested this request. Contrary to the patentee's view the opponents being parties to the proceedings have the right to take a stand vis-a-vis every request of a patentee.

2.3 At the end of the oral proceedings before the opposition division on 14 March 1997 the chairman announced that the opposition division intended to maintain the patent in amended form in accordance with the patentee's second auxiliary request. With the notification of the minutes of these oral proceedings the patentee was invited to file observations and to correct deficiencies. In his letter of 11 September 1997 to the proprietor's Japanese representative the patentee's European representative recommended maintaining the main request and the first auxiliary request in order to keep the option of filing an appeal, as indicated in a previous letter of said Japanese representative. This procedure was followed as appears from the brief of 27 December 1997 filed with the EPO. Hence it can be concluded that the patentee intended to lodge an appeal against any decision refusing the main or first auxiliary request concerning the present product claims.

2.4 When the decision under appeal was received in the office of the patentee's European representative on 5 March 1998 a date stamp containing a section "Frist" was provided on the cover sheet of the decision under appeal. However, no deadlines were noted either on the date stamp or in the central diary, which task belonged

to Mrs R. Keller to whom such decisions had to be transferred. Nor was any deadline noted by Ms Stengert in her diary where final and critical EPO deadlines had to be registered.

It could not be ascertained whether the decision under appeal was not properly transferred to Mrs R. Keller or whether she and subsequently Ms G. Stengert omitted to note the deadlines. It is only clear that after the receipt of notification of the appeal of Opponent I on 19 May 1998 the file which contained the decision under appeal was handed over to the patentee's European representative. According to Appellants O no due care was taken because the patentee's European representative only assumed that the file was found in the general office file room. However, this fact has nothing to do with the due care mentioned in Article 122 EPC.

It cannot be denied that the firm of the patentee's European representative ran an effective system for monitoring pre-time and time limits and also an effective cross-checking system for the final and critical EPO time limits. It also appears from the explanations of the patentee's European representative and from the affidavits of Mrs R. Keller and of Ms G. Stengert that the latter were experienced and qualified for that task. The same can be said of the head of administration and her assistant. As to the persons working in the incoming mail department in March 1998 they must be considered as knowledgeable and well instructed as appears from the affidavit of one of them.

From the coloured copies of both diary pages of 14 April, 4 May, 14 May, and 14 July 1998 it can be seen that these diaries were filled in accordance with the declarations of Mrs R. Keller and Ms G. Stengert in

their respective affidavits. It is true that as concerns the re-establishment of rights and the grounds of appeal no pre-time warning was noted in the diaries but this seems quite normal as the file was then in the possession of the patentee's European representative who explained that he requested Mrs R. Keller to enter only the final deadline in her diary. Moreover, said diary pages show that on a typical working day approximately 30 official deadlines were entered in the central diary in which, contrary to Appellants O's assumptions, no parts seem to have been blanked out.

Hence it has been plausibly shown that a normally effective system for monitoring time limits had been established in March 1998 and that a qualified and reliable staff was employed in the office of the patentee's European representative. Taking account of all the circumstances of the case the Board is of the opinion that the malfunction in the office of the patentee's European representative (which malfunction would not have been prevented by a mail book in which all incoming mail is entered, as suggested by the Appellants O) constituted an isolated error in an otherwise satisfactory system and that, therefore, re-establishment of rights may be granted. Thus the appeal of the patentee is admissible.

3. *Sufficiency of disclosure*

The appellant P made it clear in its written submission and at the oral proceedings that it was the intention of the patent proprietor to claim a closed composition, and the combination of the terms "comprising" and "the balance being iron and inevitable impurities" ensured that a closed composition was indeed claimed. There is no ambiguity in this respect, accordingly.

As set out in the description the present invention is based on D0 and intends to improve on the TSxT.E1 value of 2416 of the steel thereof (steel G in Table 2). The Japanese document D0 states on page 4, second paragraph that the testing method used is the JIS-5 method, so this must also be the method used for the purposes of the present patent. The testing method is, therefore, clearly defined in the context. The patent, therefore, discloses the invention in a manner sufficiently clear and complete for it to be carried out by a person skilled in the art.

4. *Amendments*

- 4.1. The only amendment made in the claims is that in claim 1 the upper limit of the range of carbon content has been changed from 0.4% to 0.21%. This amendment is based on Table 1 which lists steel species A to K, which, with the exception of species C, E, and H, have compositions falling within the terms of claim 1 as granted. The steel species in Table 1 have carbon contents varying from 0.16% up to a maximum of 0.21%. The lower limit of the carbon range remains unchanged at 0.15%.

Table 1 shows that although the carbon content varies within a relatively small range of 0.16% to 0.21%, the silicon and manganese contents vary over a relatively large range of 0.6 to 2.0%, which demonstrates that, at least within the variation range of the examples, there is no correlating link between the carbon content and the silicon and manganese contents. Therefore, claim 1 does not need to specify the range of carbon content together with the ranges of silicon and manganese contents as listed in Table 1, these being independent constituents. Similarly, the effects of the sulphur and phosphorous contents are not correlated with the carbon content and also need not be specified in claim 1.

As regards the calcium or rare earth metal contents, their influence is also not correlated with the carbon content, it is correlated with the sulphur content. The sulphur content should be kept low from the point of view of hole expansibility, but if sulphur is present then the calcium and rare earth metals spheroidize the sulphide-based inclusions. Therefore, the inclusion of sulphur and calcium relates to a quite different technical problem to that which is bound with the carbon content (see point 6.1 below).

This reasoning is in line with the decision T 201/83, according to which an amendment of a concentration range in a claim for a mixture is allowable on the basis of a particular value described in a specific example, provided the person skilled in the art could have readily recognised this value as not so closely associated with the other features of the example as to determine the effect of that embodiment of the invention as a whole in a unique manner and to a significant degree.

4.2. Therefore, the amendment of the carbon range in claim 1 is allowable under Article 123(2) EPC. It is also allowable under Article 123(3) EPC since it narrows the scope of protection. The amendment on page 4 brings the description into line with claims 1 and 2.

5. *The invention*

The outcome of the investigation under Article 52(1) EPC depends to a large extent on the parameters $TSxT.E1$ and (V_{pf}/d_{pf}) defined in claims 1 and 2, so it will first be examined as to whether these are "pseudo-features", as the appellants O effectively argue, or whether they are real, verifiable, and independently controllable features, as the appellant P argues.

Both the tensile strength and total elongation can be measured by well known methods, and these values are listed individually in both D0 (Table 2) and the patent in suit (Table 2). These parameters are measured according to the JIS-5 method as mentioned in point 2. above. It is also well known that both tensile strength and total elongation can be adjusted individually in steels, so there is no doubt that the parameter TSxT.El is a real, verifiable, and independently controllable parameter.

The invention of the patent in suit is based on the finding that in hot rolled sheets of a steel composition as indicated in claims 1 and 2 a high strength-ductility balance is fostered when a microstructure is created which is composed of ferrite, bainite and a minimum amount of retained austenite phases and in which the volume fraction of the polygonal ferrite is increased and its average grain size is decreased. The patent also teaches and claims in claims 4 to 12 sequences of process steps by which such a microstructure and the favourable properties resulting therefrom can be achieved. Consequently, the process claims must be read such that, within the given limits, the parameters of each step must be so correlated with those of the other steps that the minimum values for TSxT.El and (V_{pf}/d_{pf}) are exceeded. Since the description contains detailed explanations of how each step influences the microstructure, the skilled person is in a position to find the correct correlations.

That the parameter (V_{pf}/d_{pf}) is independent of the volume fraction of retained austenite (V_v) and not directly correlated with it is demonstrated by Figures 1 and 2 of the patent in suit. Figure 2 shows that TSxT.El can become approximately 3000 at a value of (V_{pf}/d_{pf}) of less than 7, whereas Figure 1 shows that V_v must be about 12%

to attain a TSxT.El value of 3000. Therefore, even for $V_v > 5$ (V_{pf}/d_{pf}) may be less than 7. Thus these parameters are controllable independently of each other.

Therefore, the parameters TSxT.El and (V_{pf}/d_{pf}) are verifiable and independently controllable parameters of the steel of the patent in suit, and their use is not an attempt to disguise lack of novelty of a known steel. The Board is of the opinion that in the present case the microstructure of the steel is not easily defined, and by specifying the parameters TSxT.El and (V_{pf}/d_{pf}) instead the characteristics of the steel are defined relatively concisely, so that this manner of defining the claimed steel, far from being an attempt to disguise a known steel, is appropriate in the context.

6. *Novelty*

The document D1 was regarded by the appellants O and the opposition division as the closest prior art document, and was considered by them as anticipating at least the subject-matter of claims 1 and 4. That this is not the case is evident from the facts that D1 does not discuss the parameter (V_{pf}/d_{pf}) or state explicitly that the steel is a purely three-phase steel, nor does it disclose a total draft of the hot finishing rolling of at least 80%, the cooling speed of the fast cooling step, or the relationship of the cooling regime with the temperatures Ar_3 and Ar_1 . For these reasons the subject-matter of all the claims is novel.

7. *Inventive step*

7.1 The technical problem

The invention relates to a hot rolled steel sheet for use in automobiles and in industrial machinery, where high strength, combined with excellent formability, and weldability are important factors. The steel employs the so-called TRIP (transformation induced plasticity) effect to attain the desired properties. The hot rolled steel sheet is produced in a continuous hot-strip mill using a series of heating and rolling steps and the process culminates in a coiled strip ready for use by the end user. Subsequent cold rolling and annealing steps are dispensed with.

It was previously known to make TRIP steels using high alloy steels including large amounts of elements such as nickel, molybdenum, and chromium (for example D4), and it was also known to make TRIP steels using high carbon steels (for example D0). Since carbon tends to stabilise the austenite phase it is relatively easy to make a high carbon steel with a retained austenite phase that is metastable at room temperature. A high carbon steel has the drawback, however, that it is less weldable than a low carbon steel and has a reduced toughness in its finally formed state.

Therefore, the invention sets out to produce a low carbon hot rolled TRIP steel sheet. It is relatively more difficult to stabilise the austenite in such steels so that the desired value of 2416 for the strength-ductility balance is not easily achieved. The objective problem that the patent seeks to solve is to assure the production of a low carbon steel with the desired high value of the strength-ductility balance > 2416, accordingly.

7.2 The closest prior art

The Board agrees with the parties that D1 is the closest prior art document since it relates to a low carbon hot rolled TRIP steel sheet having a strength-ductility balance $TSxT.E1 > 2416$, a composition in accordance with claim 1 (Table 1), and a retained austenite phase contained in an amount of 5% or more by volume on the basis of the total phases (Figure 3).

This document does not discuss the microstructure of the steel, and in particular that the steel thereof has a purely three phase microstructure composed only of ferrite, bainite and retained austenite phases, and it does not discuss the ratio (V_{pf}/d_{pf}). Figures 2A to 2C indicate that the austenite phase is maximised at a coiling temperature below about 380°C, and Figure 1 indicates a rapid cooling step after coiling, which would tend to favour the growth of the martensite phase. There is also no mention of a high draft of 80% to refine the grains.

7.3 Figure 3 of this document demonstrates that even if the percentage of retained austenite exceeds 5%, the value of $TSxT.E1$ does not necessarily exceed 2416. In order to guarantee this minimum value of 2416 in low carbon steels the inventors of the patent in suit have looked into the mechanism underlying the TRIP phenomenon and have discovered that the microstructure of the retained austenite is island-like that is metastabilised at room temperature by carbon enrichment of the austenite phase. When ferrite transformation is carried out under appropriate conditions the carbon concentration rises in untransformed austenite grains. When the carbon concentration is high at the time of bainite transformation it remains as retained austenite phase.

The sites at which the carbon concentration is highest and where the austenite is most easily retained, are the boundaries between the ferrite phase and the untransformed austenite phase, and the extent of the boundaries is related to the ratio (V_{pf}/d_{pf}) . By controlling the microstructure specifically as to the ferrite volume and grain diameter, and promoting transformation partially into bainite but avoiding the formation of pearlite and martensite, the desired result can be achieved. In particular, if care is taken to adjust the parameter $(V_{pf}/d_{pf}) > 7$ then the carbon is bound more effectively and is not available for formation of the pearlite and martensite phases, and the desired result is assured (see page 4, line 53 to page 5, line 7, and page 5, lines 17 and 18). Table 2 and Figure 5 of the patent confirm the result that for those steels that have the claimed low carbon composition and are processed according to the invention so as to avoid the formation of pearlite and martensite, then if $(V_{pf}/d_{pf}) > 7$ the result TSxT.El > 2416 is achieved.

- 7.4 In order to provide the required microstructure and avoid the formation of pearlite and martensite the rolling temperature, the draft in the hot finish rolling, the cooling regime, and the coiling temperature are chosen within respective critical ranges, as set out on page 5, line 20 onwards. The cooling regime, in particular is critical, and is defined by reference to the Ar_3 and Ar_1 temperatures and selected with a view to proper ferrite formation, carbon enrichment of the retained austenite phase, refinement of the ferrite grains, and avoiding the formation of pearlite and martensite, as described on page 6 with reference to Figures 6 and 7. The step of cooling through the Ar_1 temperature at a rate of more than 40°C/s is particularly important (page 6, lines 22 and 23).

Although the cooling regime shown in Figure 1 of D1 resembles the regimes of Figures 6 and 7 of the patent, it gives no details of the cooling rates or the relationship of the cooling regime with the A_{r_3} and A_{r_1} temperatures. It cannot be excluded that pearlite and martensite are formed, or guaranteed that the condition $(V_{pf}/d_{pf}) > 7$ is met. There is no teaching that this parameter or the microstructure is of importance for the TSxT.E1 value. The same comments apply to D8, whose steel, moreover, has a composition not falling with the terms of claims 1 and 2.

- 7.5 The prior art as a whole does not pay any attention to the parameter (V_{pf}/d_{pf}) or to the importance of avoiding the formation of pearlite and martensite in low carbon steels so as to promote the TRIP effect. This teaching of the patent in suit is new and forms the basis of a patentable invention.

Document D28 describes the TRIP effect but in cold rolled steel sheets, which, after hot rolling and coiling, require further processing. Cold rolled steels have a quite different microstructure and properties to hot rolled sheet, and the technology of cold rolled steel sheets cannot readily be applied to hot rolled steel sheets, so that the teaching of D28 would not be applied by the person skilled in the art to hot rolled trip steels. The aim of the patent in suit is to control the microstructure of hot rolled steels, but the parameter (V_{pf}/d_{pf}) is not of any particular relevance to cold rolled steels.

In fact the three-phase structure defined in the independent claims, the ferrite component of which has the required V_{pf} and d_{pf} values, can only be formed in a hot rolled steel that is cooled but cannot be formed in a cold rolled steel that is reheated. The steel of D28, moreover, is a high carbon steel in that the carbon content is 0.395%. The person skilled in the art would not consider invoking the teaching of D28 for the present problem, accordingly.

Document D2 relates to a cold rolled dual phase steel sheet whose carbon and silicon contents differ from those of claim 1. D4 requires the addition of chromium which the patent in suit seeks to avoid. D29 and D30 do teach that a draft greater than 80% is well known, but not in the context of influencing the parameter (V_{pf}/d_{pf}).

Therefore, the prior art does not suggest adjusting this parameter or the specific cooling regimes defined in claims 4 and 5 in the context of low carbon TRIP steels. In view of the above considerations claims 1, 2, 4, and 5 all involve an inventive step.

Order

For these reasons it is decided that:

1. The proprietor's request for re-establishment of rights is allowed and its notice of appeal is considered as having been filed in due time.
2. The decision under appeal is set aside.
3. The case is remitted to the first instance with the order to maintain the patent in amended form on the basis of claims 1 to 12 and page 4 of the description, all submitted at the oral proceedings, the rest of the description as granted and the figures as granted.

The Registrar:


V. Commare

The Chairman:


W. D. Weiß

M
8.1.03

