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DECISION of 30. Januar 2006

| Case Number: | T 1136/03 - 3.2.03 | |
|---------------------|---|--|
| Application Number: | 95913335.6 | |
| Publication Number: | 0706845 | |
| IPC: | B22D 11/06, B22D 11/12, B22D 11/124, C21D 8/04 | |

Language of the proceedings: EN

Title of invention: Method of production of thin strip slab

Patentee:

NIPPON STEEL CORPORATION

Opponent:

BHP STEEL (JLA) PTY.LTD.

Headword:

Relevant legal provisions: EPC Art. 88, 84, 83, 54, 56

Keyword:

"Novelty - implicit features" "Inventive step - exclusion of hindsight"

Decisions cited:

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Catchword:

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Beschwerdekammern

Boards of Appeal

Chambres de recours

Case Number: T 1136/03 - 3.2.03

DECISION of the Technical Board of Appeal 3.2.03 of 30. Januar 2006

| Appellant: (Opponent) | BHP STEEL (JLA) PTY.LTD. 1 York Street Sydney, NSW 2000 (AU) |
|---|---|
| Representative: | Lerwill, John A.A. Thornton & Co. 235 High Holborn London WC1V 7LE (GB) |
| Respondent: (Proprietor of the patent) | NIPPON STEEL CORPORATION 6-3 Otemachi 2-chome Chiyoda-Ku Tokyo 100-71 (JP) |
| Representative: | Vossius & Partner Siebertstrasse 4 D-81675 München (DE) |
| Decision under appeal: | Interlocutory decision of the Opposition Division of the European Patent Office posted 30 July 2003 concerning maintenance of European patent No. 0706845 in amended form. |

Composition of the Board:

| Chairman: | U. | Kra | ause | Э |
|-----------|----|--------|------|-------|
| Members: | G. | Ashley | | |
| | J. | P. | в. | Seitz |

Summary of Facts and Submissions

- I. European patent 0 706 845 concerns thin strip casting of carbon steel, and in particular relates to the scale formed on the cast strip. The patent is based on European patent application 95 913 335.6, filed on 24 March 1995. The application claimed priority from Japanese patent applications JP 5583594 (25 March 1994), JP 5597794 (25 March 1994), JP6617494 (4 April 1994) and JP 6720194 (5 April 1994), which were duly submitted to the EPO together with English translations.
- II. The appeal lies from the interlocutory decision of the opposition division to maintain the patent in amended form according to the second auxiliary request filed during the oral proceedings held on 6 June 2003. The written decision was dispatched on 30 July 2003. The appellant (opponent) filed the Notice of Appeal on 7 October 2003, paying the appeal fee on the same day. The statement of the grounds of appeal was filed 8 December 2003.
- III. The appellant did not oppose maintenance of independent claims 1 and 3 of the patent as amended, but limited the appeal to independent claims 2 and 4, which read as follows:

"2. A process for producing a thin cast strip which has a scale excellent in press peeling-resistant properties wherein a carbon steel comprising up to 0.5% of C and less than 0.1% of Cr or Cu is cast into a thin cast strip having a thickness up to 10 mm by a continuous casting machine having mold walls which move in synchronization with the cast strip, and the thin cast strip is coiled in a coil form by a coiler, the process for producing the thin cast strip with a reduced surface scale comprises the steps of holding the thin cast strip, subsequently to casting into the strip, in an atmosphere comprising up to 5.0% oxygen and the balance being a nitrogen gas to a temperature of 1,200°C or lower, then cooling the cast strip sent out of said atmosphere at a rate of at least 10°C/sec through a temperature region to 750°C, and cooling the cast strip in a coil form by the coiler at a temperature up to 600°C, the process being such that the scale contains Fe_3O_4 as its main component."

"4. A process for producing a thin cast strip which has a scale excellent in press peeling-resistant properties wherein a carbon steel comprising up to 0.5% of C and at least 0.1% of Cr or Cu is cast into thin cast strip having a thickness up to 10 mm by a continuous casting machine having mold walls which move in synchronization with the cast strip, and the thin cast strip is coiled in a coil form by a coiler, the process for producing the thin cast strip with a reduced surface scale comprises the steps of holding the thin cast strip, subsequently to casting into the strip, in an atmosphere comprising up to 7.0% oxygen and the balance being a nitrogen gas to a temperature of 1,200°C or lower, then cooling the cast strip sent out of said atmosphere at a rate of at least 10°C/sec through a temperature region to 750°C, and cooling the cast strip in a coil form by the coiler at a temperature up to 600°C, the process being such that the scale contains Fe_3O_4 as its main component."

IV. The appellant had based his opposition on the grounds of insufficient disclosure (Article 100(b) EPC) and lack of novelty and/or inventive step (Article 100(a) EPC), citing inter alia the following documents:

> D1: JP-A-6339752, published 13 December 1994; D2: JP-A-6335706, published 6 December 1994. Both D1 and D2 were provided with translations in English, and it is the translations that are referred to in this decision.

MA-3: a set of graphs showing cooling rates for steel formed by strip casting; MA-4: the iron-oxygen equilibrium phase diagram; These documents were submitted in the opposition proceedings as exhibits attached to the First Statutory Declaration of Massoud Assefpour, dated 15 March 2000.

V. On 23 September 2005 the respondent (proprietor of the patent) filed a first auxiliary request, in which independent claims 2 and 4 were amended to add, at the end of the claims, the feature "and the scale thickness is up to 10 μ m", and a second auxiliary request, in which independent claim 2 was deleted.

Oral proceedings were held on 29 September 2005, at the end of which the Board announced the intermediate decision that the claims of the first auxiliary request were found to be patentable, and that the proceedings would be continued in writing with a time limit of one month set for the respondent to file a revised description, a further time limit of one month thereafter was set for the appellant to comment on the revised description. The respondent duly filed an amended description on 27 October 2005. In replies dated 30 November 2005 and 4 January 2006, the appellant pointed out that during the oral proceedings held on 29 September 2005, the respondent had withdrawn the claims to priority in relation to claims 2 and 4, and that this should be evident from the patent specification itself, in particular that D2 should be identified as being prior art under Article 54(2) EPC. In a communication dated 19 December 2005, the Board assured the respondent that this written decision would clearly state that the disputed patent makes no claim to priority in respect of claims 2 and 4.

- VI. The arguments of the parties can be summarised as follows.
 - (a) Priority:

In his letter of 23 August 2005, the appellant submitted that the priority claimed in accordance with Article 88 EPC could not be acknowledged, since the combination of features set out in claims 2 and 4 could not be derived from any of the priority documents listed in paragraph I above. The respondent sought to have this ground dismissed as being a late-filed fresh ground of opposition, which had not been mentioned in the statement of the grounds of appeal; the respondent considered the appellant's submission at such a late stage to be a procedural abuse and contrary to the Rules of Procedure of the Boards of Appeal (OJ 3/2003, 89), which require the statement of the grounds of appeal to contain a party's complete case.

(b) Articles 83 and 84 EPC

Claims 2 and 4 were amended during the opposition procedure to add the feature "the process being such that the scale contains Fe_3O_4 as its main component". The appellant submitted that it is not clear which conditions must be met for the scale to contain Fe_3O_4 as its main component, and the skilled person is faced with the task of having to make a selection of parameters from within the claimed ranges.

The respondent explained that Fe_3O_4 results from the process conditions defined in claims 2 and 4, and indicates to the skilled person that a combination of parameters within the claimed limits must be chosen with a view to creating this oxide. The patent specification gives concrete values within the claimed ranges, which clearly demonstrate how the required scale composition can be achieved.

(c) Novelty and Inventive Step of Claims 2 and 4 of the Patent as Amended (Main Request).

Document D1:

The appellant argued that D1, which was to be considered to be prior art owing to the invalid priority date of the patent, discloses a process for producing thin strip, in which the cast strip is held in an atmosphere comprising up to 5% oxygen, the balance being nitrogen (see "practical embodiment 2"). The cast strip is sent out of this atmosphere when it leaves chamber 11, which is at 950°C, and is then cooled in successive chambers to below $750 \,^{\circ}\text{C}$ at a rate calculated to be greater than $10 \,^{\circ}\text{C/s}$. It is implicit in the process of D1 that the strip is coiled, and that this must occur at a temperature below $600 \,^{\circ}\text{C}$. The ranges defined in claims 2 and 4 for Cr and Cu contents are commensurate with the impurity levels for carbon steels and hence provides no novel feature. Since all the process steps of claims 2 and 4 are disclosed in D1, the resulting scale on the surface of the steel strip must inevitably be Fe₃O₄.

The respondent argued that chambers 11 to 13 all contain the same nitrogen-based atmosphere, in which the cast strip is kept until it cools to 520°C; the strip cannot therefore be sent out of this atmosphere and cooled to 750°C. The teaching of D1 is that when nitrogen is used, the strip should be shielded to a low temperature in order to reduce scale; this however, is contrary to the patent, which requires that the strip is sent out at a temperature above 750°C. The step of coiling is not shown in D1, consequently the coiling temperature is not disclosed. In summary, there is no disclosure in D1 of the steps required to produce a cast strip having a scale that mainly contains Fe₃O₄ that has excellent press peeling-resistant properties.

Document D2:

The appellant explained that D2, which also forms prior art owing to the invalid priority claim, describes a process for producing thin strip, in which the cast strip is held in an atmosphere comprising 0.1 to 5% oxygen. Although the balance is not explicitly disclosed, the automatic choice would be nitrogen, as it is cheap and readily available. The hot rolled strip is water cooled, which implies a rate of at least $50^{\circ}C/s$, and certainly greater than $10^{\circ}C/s$, as defined in claims 2 and 4. Although the type of oxide is not mentioned in D2, it would inevitably be Fe₃O₄, as all the claimed process conditions are satisfied by D2.

Further, the skilled person would know from the ironoxygen equilibrium diagram (MA-4) that, as set out in the statutory declaration of Mr Assefpour, Fe_3O_4 will be formed after cooling the strip to the coiling temperature of 550°C (see Tables 1 and 2 of D2).

The respondent pointed out that the balance gas is not disclosed in D2, and the skilled person could choose from several, such as argon and exhaust gas, as mentioned in the disputed patent. In addition, there is no mention of a link between the shielding gas and the resulting scale composition. Referring to Figure 3 and examples in the patent specification, the respondent argued that water cooling does not necessarily lead to cooling rates above 10°C/s. D2 also does not disclose the nature of the oxide film, neither is this derivable from the document.

(d) Novelty and Inventive Step of the First Auxiliary Request

The first auxiliary request additionally defines the thickness of scale as being less than 10 μ m. The appellant argued that this is not a feature of the process, and is merely an inevitable consequence of the steps that have already been discussed. The thickness of the oxide film results from the oxygen concentration

in the nitrogen atmosphere and the cooling rate; this is demonstrated in Figure 5 of the patent, which shows that an oxygen concentration of less than 5% leads to a scale less than 10 μ m in thickness, and Figure 6 shows that a cooling rate of greater than 10 °C/s also leads to the desired thickness. Since D2 describes a process having the same oxygen content and cooling rates, a scale of less than 10 μ m must inevitably be produced. Such a thin scale layer was described in D1 as being formed under similar conditions.

The respondent, referring to paragraph [0030] of the patent, argued that thickness of scale is not just a consequence of oxygen content and cooling rates, but also of other factors such as temperatures. D2 makes no mention of thickness, and in particular that Fe_3O_4 forms a dense, stable oxide if it is kept below 10 µm, which does have to be removed prior to press forming. In addition, no conclusion regarding the thickness of film produced in D2 could be drawn from D1, because on D1 the strip is shielded all the way down to a temperature of less than 500°C.

VII. Requests:

The appellant requested that the decision under appeal be set aside, and the patent revoked to the extent of independent claims 2 and 4.

The respondent requested that the appeal be dismissed or that the patent be maintained on the basis of either one of his two auxiliary requests filed on 23 September 2005.

Reasons for the Decision

1. The appeal is admissible.

2. Priority

During the appeal proceedings the appellant, citing Article 88 EPC, contested the validity of the claimed priority. The issue of priority, albeit with respect to Article 87 EPC, had been raised by the appellant during the proceedings before the first instance and was also discussed in the statement of grounds of appeal. The Board considered the issue of priority to be pivotal in the assessment of novelty and inventive step, and hence admitted the appellant's submissions into the proceedings.

None of the priority documents discloses the step of holding cast strip in an atmosphere comprising up to 5.0% oxygen, the balance nitrogen, combined with the feature that the scale contains Fe_3O_4 as its main component. The priority documents also provide disclosures that conflict with those set out in the disputed patent. In addition, it was apparent to the Board that there were serious discrepancies between the original disclosures in the Japanese patent applications and the translations supplied by the respondent; no explanation was given by the respondent for the reason for the discrepancies.

In light of the above, the respondent withdrew the claims to priority in respect of claims 2 and 4, with the consequence that the patent has a relevant filing date of 24 March 1995, and that documents D1 and D2 are prior art under Article 54(2) EPC.

3. Articles 84 and 83 EPC

The appellant submits that it is not clear how the amended feature, namely a scale containing Fe_3O_4 as the main component, can be produced (Article 84 EPC). This is also linked to the question as to whether the patent discloses the invention in a manner sufficiently clear and complete for it to be carried out by the skilled person (Article 83 EPC), a ground that was raised by the appellant in the notice of opposition. It is therefore appropriate that the Board considers compliance with both of these Articles.

The Board is of the view that, rather than the inevitable result of the defined process steps, the requirement that the main component of the scale is Fe_3O_4 is to be understood as a functional feature, which determines the selection of appropriate parameters, within the defined ranges, and limits the combinations of parameters to those giving the required oxide. A lack of clarity within the meaning of Article 84 EPC does not arise merely because a feature is defined in functional terms.

The appellant argued that such combinations are not readily apparent to the skilled person. But the description provides several examples (see Tables 5 and 6) which lead to a predominantly Fe₃O₄ scale, thereby meeting the requirement of Article 83 EPC.

4. Main Request

4.1 Novelty

Document D1:

D1 describes a process for producing thin cast strip in which the cast strip passes through a series of chambers (11 to 15) that are held at progressively lower temperatures. Of particular relevance is the example designated "practical embodiment 2", according to which the first three chambers (11 to 13) contain a nitrogen gas atmosphere with 0.5 vol.% oxygen; chambers 14 and 15 contain air.

In dispute is whether D1 discloses the feature of claim 2, "cooling the cast strip sent out of said atmosphere". Claim 2 defines "said atmosphere" as comprising up to 5% oxygen and the balance nitrogen and that cooling takes place through a temperature region to 750°C.

The appellant argued that although chambers 11 to 13 nominally have the same atmosphere, in practice there would be differences between the atmospheres. In particular, the first chamber (11) is at a high temperature and the iron on the surface of the strip would react to form oxide, thereby consuming oxygen from the chamber's atmosphere. Thus, the strip is sent out of this atmosphere and into one of a different composition when it leaves chamber 11 and enters chamber 12.

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However, the Board is of the view that "said atmosphere" in claim 2 refers to the protective atmosphere in which the oxygen content is limited to 5%. The first three chambers of practical embodiment 2 all contain a nitrogen atmosphere having less than 5% oxygen, and hence the strip of D1 is only "sent out of said atmosphere" when it leaves chamber 13 and enters the fourth chamber containing air. Since chamber 13 is already at 520°C, the strip cannot then be cooled to 750°C.

The processes of claims 2 and 4 thus differ from D1 at least in terms of this feature, and are thus novel.

Document D2:

Claim 2 requires that the cast strip is cooled at a rate of at least 10°C/s through a temperature region to 750°C, and the respondent is of the view that this cooling rate is not disclosed in D2. According to D2, the hot rolling temperature is between 900°C and 1200°C (see page 10, line 14), and commences at a cooling velocity of from 10°C/s to 30°C/s (see page 9, lines 18 to 20). After hot rolling, the sheet is water cooled, for example by water spray (see page 10, line 3 and page 11, line 10) to the coiling temperature, which lies between 400°C and 650°C. D2 further states that it is desirable that the cooling be performed rapidly after conclusion of hot rolling in order to prevent the loss of the smooth surface formed by hot rolling due to the scale that may be formed after hot rolling (see page 10, lines 21 to 23). The respondent held the view that this refers to the fact that there is no delay between the end of hot rolling and the start of cooling,

rather than indicating the rate of cooling itself. However, given that the cooling rate at the start of hot rolling is 10°C/s to 30°C/s, and it is said that after hot rolling cooling is to be performed rapidly, it would be expected that the cooling rate would be at the very least 10°C/s, particularly as D2 instructs that cooling must be fast enough to preserve the smooth surface formed by hot rolling. The respondent also submitted that cooling by water does not necessarily mean that the cooling rate is greater than 10°C/s, as shown in Figure 3 of the patent. Although the patent states that the cast strip is cooled at a rate of at least 10°C/s with atomized water (see paragraph [0015]), and Figure 3 shows one cooling rate greater than $10^{\circ}C/s$, it is not clear whether this particular value was achieved with or without the use of water. The Board finds the evidence supplied by the appellant (see MA-3) more persuasive; this demonstrates that thin steel strip cooling in air has a cooling rate greater than 10°C/s, so the use of water cooling would lead to rates higher than this. Consequently, it is considered that D2 discloses the defined cooling rate.

According to D2, after casting, the steel strip is cooled in an atmosphere containing 0.1 to 5% oxygen, but the rest of the atmosphere is not explicitly disclosed. The appellant argued that in the field of casting, shielding with nitrogen is very common, it being a cheap gas that is readily available. Since the use of nitrogen as the balance gas would be the first choice for the skilled person, this feature is directly and unambiguously derivable from D2. This argument does not take into account that there are several possible gases from which the skilled person can choose a shielding gas, for example nitrogen, argon and exhaust gas. It might be that nitrogen is the one that he would most readily turn to, but such a selection is more a question of obviousness. Since it cannot be said that the skilled person would unequivocally select nitrogen at the exclusion of all other inert gases, the Board does not consider this feature to be disclosed in D2, and consequently the processes of claims 2 and 4 are novel with respect to D2.

4.2 Inventive Step

Document D2 concerns a process for producing thin cast strip having good surface quality, and is seen as an appropriate starting point for the invention. The process of claim 2 differs from that described in D2 in that gas forming the balance of the atmosphere is defined as being nitrogen. Whereas claim 2 defines the type of oxide forming the scale to be Fe_3O_4 , D2 is silent regarding the nature of the scale.

As mentioned above, the skilled person faced with selecting a gas to provide shielding for the cast strip can choose typically from argon, exhaust gas and nitrogen. Of these, the Board is of the opinion that nitrogen would indeed be the most obvious first choice, because of the fact that it meets the requirement of providing inert cover, and it is cheap and readily available.

Having concluded that nitrogen would be chosen, it is now necessary to determine the type of oxide that would form on steel strip manufactured by the process of D2. It is common general knowledge that the stable low temperature form of oxide is Fe_3O_4 , as shown in the iron-oxygen equilibrium phase diagram, an example of which is given in MA-4. The respondent argued that nonequilibrium conditions exist in coil, particularly towards the centre, where it is difficult for atmospheric oxygen to penetrate. However, Figures 4, 7, 10 and 13 of the disputed patent all show that coiling below about 600°C leads to a predominantly Fe_3O_4 structure. The patent also explains (paragraph [0025]) that when the cast strip is held at temperatures down to at least 1200°C in a nitrogen-based atmosphere, nitrogen enriches the surface suppressing the penetration of oxygen into the surface. As a result, the formation of FeO is inhibited and the scale contains Fe_3O_4 as the main component.

The strip of D2 would also be held in a predominantly nitrogen atmosphere prior to cooling, thereby inhibiting FeO formation. It is then cooled directly to the coiling temperature, which is below 600°C (all the examples shown in Table 1 of D2 are coiled at 550°C). All of these steps in D2 are conducive to forming a scale with Fe₃O₄ as its main component.

Since the choice of nitrogen as the balance gas for the atmosphere containing 0.5% to 5% is obvious for the skilled person, and the consequence is that the scale would mainly contain Fe_3O_4 , the process defined in claim 2 lacks an inventive step.

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5. First Auxiliary Request

5.1 Inventive Step

Claim 2 of the first auxiliary request also differs from D2 in that the balance gas of the holding atmosphere is nitrogen, so novelty is not in question. The claim further defines the Fe_3O_4 scale as having a thickness of up to 10 μ m.

The disputed patent sets out to improve the surface properties of cast strip, and addresses the problem that during press working or bending scale peels off, thereby impairing the surface properties of the products (see paragraph [0003]).

The proposed solution is to ensure that the Fe_3O_4 scale is thin, with a thickness up to 10 μ m. Whereas thick films of Fe_3O_4 tend to peel, thin films are mechanically sound and can withstand bending, such as occurs during press forming, without causing surface defects.

Document D2 is concerned with controlling scale formation prior to and during hot rolling, and surface quality is assessed by measuring the surface roughness after the cast strip has been pickled to remove the film. There is no mention of the nature of the film on the cast strip, in particular its thickness, and the relevance of the thickness for mechanical properties of the film or suitability for press forming. The skilled person is not provided with any hint from D2 of either the problem of having a stable surface oxide film that can withstand bending, or the solution of limiting the thickness. - 17 -

The appellant argued that, having selected nitrogen as the balance gas, the oxide film on a steel strip made by the process of D2 would inevitably have a thickness less than 10 µm. However, within the context of inventive step, it is necessary to consider the disclosure of the document as a whole and assess whether it gives the skilled person any indication of the problem and/or its solution, and for the reasons set out above, this is not the case here. There is no evidence that, with nitrogen as the balance gas and by following the process of D2, it is inevitable that a film of less than 10 µm is produced; furthermore, this is not what D2 as a whole is teaching, and can only be gleaned with hindsight. D2 is concerned with the problem of surface roughness resulting from high temperature scale formation, rather than improving the mechanical properties of the scale by limiting its thickness. The skilled person is not made aware that the purpose is to produce a thin film, and that this objective influences the choice of atmosphere gas, cooling rates, coiling temperatures etc. Whereas there is an expectation from general knowledge, that the final film would have an Fe_3O_4 structure, there is no expectation regarding the thickness and its significance for press forming without knowledge of the invention itself.

None of the documents referred to by the appellant gives any indication of the significance of thickness and press forming properties. In particular, the problem or the solution cannot be derived from D1, although D1 discloses a thin cast strip having a scale thickness of less than 10 μ m. The purpose of D1 is to reduce the amount of scale formed, because oxidation of thin strip leads to a significant loss of iron. There is no indication of the effect of a thin film on mechanical properties of the scale. Further, the solution given in D1 is to cloak the cast strip in a protective atmosphere right down to 500°C, which indicates that the process of D1 is significantly different to that of D2, where the strip leaves the protective atmosphere immediately after hot rolling. There is thus no motivation for the skilled person to consult D1 for a solution to the problem.

- 6. Since the processes defined in claims 2 and 4 of the first auxiliary request are considered to be novel and have an inventive step, it is not necessary to consider those of the second auxiliary request.
- 7. The respondent amended the description to bring it into agreement with the claims of the first auxiliary request, and to include a reference to D2. The appellant submitted that it should be evident from the patent specification itself that the claims to priority in respect of claims 2 and 4 had been withdrawn. The Board sees no need for this step, since the withdrawal of priority is clear from this written decision (see paragraph 2 of the "Reasons" above). D2 is mentioned in the description and it follows that this document is prior art under Article 52(4) EPC; this is also stated in paragraph 2 of the "Reasons" above. Consequently, the Board sees no need for further amendments.

Order

For these reasons it is decided that:

- 1. The decision under appeal is set aside.
- 2. The case is remitted to the opposition division with the order to maintain the patent on the basis of the claims set out in the first auxiliary request filed on 23 September 2005 and amended description pages 2, 2a, 3, 6 and 8 to 16, filed on 27 October 2005.

The Registrar:

The Chairman:

A. Vottner

U. Krause