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D E C I S I O N
of 30 January 1997

Case Number: T 0786/93 - 3.2.2

Application Number: 86305632.1

Publication Number: 0212856

IPC: C22C 38/60

Language of the proceedings: EN

Title of invention:

Continuous-cast low-carbon resulfurized free-cutting steel

Patentee:

NIPPON STEEL CORPORATION

Opponent:

Thyssen Stahl AG
Saarstahl AG
UNIMETAL S.A.

Headword:

Free-cutting steel/NIPPON STEEL CORPN.

Relevant legal provisions:

EPC Art. 56

Keyword:

"Inventive step - (no) "

Decisions cited:

-

Catchword:

-



Case Number: T 0786/93 - 3.2.2

D E C I S I O N
of the Technical Board of Appeal 3.2.2
of 30 January 1997

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Decision under appeal: Decision of the Opposition Division of the
European Patent Office posted 7 July 1993
revoking European patent No. 0 212 856 pursuant
to Article 102(1) EPC.

Composition of the Board:

Chairman: H. Seidenschwarz
Members: R. Lunzer
J. De Preter

Summary of Facts and Submissions

- I. European patent No. 212 856 was granted on 17 October 1990 on the basis of application No. 86 305 632.1 filed on 22 July 1986, claiming a priority date of 24 July 1985 based on JP application No. 162047/85.

Claim 1 of the patent as granted took the following form:

"A continuous-cast low-carbon resulfurized free-cutting steel steel consisting, in weight percentage, of

C: 0.05-0.15,
Mn: 0.5-1.5,
P: 0.05-0.10,
S: 0.15-0.40,
O: 0.010-0.020,

one or more of Pb, Bi, and Te as accompanying elements for improving machinability at the following content:

Pb: 0.05-0.40,
Bi: 0.05-0.40, and
Te: 0.003-0.10,
Si: 0.003 or less,
Al: 0.0009 or less, and

the remainder consisting of Fe and unavoidable impurities, and contains a manganese sulfide-base inclusion with the provision that:

a mean sectional area of the manganese sulfide-base inclusion present in a sectional area of 1 mm² in the rolling direction of the steel is not less than 30µm²; and

a rate of the number of manganese sulfide-base inclusions not in the form of a complex with oxide is not less than 80% of the total amount of manganese sulfide-base inclusion."

II. Three oppositions were filed by the Respondents on the ground of Articles 100(a) and (b) EPC, alleging lack of novelty (Article 54 EPC), lack of any inventive step (Article 56 EPC) and insufficiency of disclosure. The Opponents relied in particular on the following documents:

T1: Conference paper "Qualities of Strand-Cast Resulfurized Free-Machining Steels" by S. Ohtani et al. published at a conference of the ASM entitled "High Productivity Machining: Materials and Processes" held on 7 to 9 May 1985 at New Orleans, USA,

T4: "Stahl und Eisen", 104 (1984) No. 22, pages 1154 to 1160,

T5: "Kawasaki Steel Technical Report", No. 8, Sept. 1983, pages 77 to 85,

U1: Conference paper "Development of a Low-Carbon Resulfurized Free-Cutting Steel by Continuous Casting Process" by Y. Yamamoto et al., published at the conference identified in connection with document T1 above, pages 181 to 188,

U2: "Journal of Metals", June 1967, pages 29 to 32.

III. By its decision given orally on 13 May 1993, and issued in writing on 7 July 1993, the Opposition Division found that although the alleged invention was disclosed in a manner sufficiently clear and complete for it to be carried out by a skilled person, and was novel, it

lacked any inventive step. It regarded document T1 as being the closest prior art, since it dealt with continuously cast low carbon lead-alloyed free-cutting steels having MnS inclusions. The disclosure of document T1 differed from the subject-matter of Claim 1 of the patent in suit in that it made no express mention of the claimed low upper limits for

- (a) oxygen of 0.020%,
- (b) silicon of 0.003%, and
- (c) aluminium of 0.0009%,

nor did it disclose in the same terms as Claim 1 in suit -

- (d) the mean sectional area of the MnS inclusions specified in Claim 1, nor
- (e) the rate of the number of manganese sulphide-base inclusions not in the form of a complex with oxide being not less than 80% of the total amount of the manganese sulphide-base inclusion.

As to these five points of distinction, it was held with respect to feature (d) that Figures 5 and 18 of document T1 showed sulphide particles of more than the required minimum size. As to features (a), (b) and (c), document T1 taught that "oxides, such as aluminates and silicates were to be avoided since they were detrimental to machinability" (page 141, left column third paragraph and page 142, right hand column, last paragraph but one), while feature (e) was achieved as a direct consequence of keeping the proportions of oxides, Si and Al as low as possible. Hence all that had to be decided was whether the specific values for (a) to (c) claimed in the patent in suit involved an inventive step, or in contrast could be derived from the general teaching of document T1 to keep the

relevant values low. The teaching of document T4 pointed in the same direction towards low values for oxygen, Si and Al, as also did the documents T5 and U1. Accordingly it was held that as it was the unanimous teaching of all of these documents to keep the amounts of oxides, Si and Al low, it only required a limited amount of experimentation to find their optimum levels. This conclusion was also supported by document U2 which confirmed the undesirable effect of even small proportions of Si and Al. Therefore, the subject-matter of Claim 1 did not involve an inventive step

IV. An appeal against that decision was filed on 6 September 1993, the appeal fee was paid on the same day, and the statement of grounds of appeal was filed on 8 November 1993.

In that statement, and during oral proceedings held on 30 January 1997, the Appellant argued that the Opposition Division's decision ignored the fact that the present invention was not directed, as was the cited prior art, to achieving improved machinability, but was instead directed to the different goal of attaining a smoother surface in the machined products. It was therefore inappropriate to compare with prior art such as the teaching of document T1, which was directed to improved machinability, measured in terms of tool life.

Relatively large particles of MnS were known to be a pre-requisite for obtaining good machinability, but their production required relatively slow solidification, which was not easily achieved during continuous casting. The description of the patent in suit showed in Table 1 that products made in accordance with the invention had a surface roughness of 10 μm or less. That had to be contrasted with the surface roughness according to Figure 10 of document T1 of 12

to 30µm. There was no pointer in document T1 or in any other document to suggest how it might be possible to obtain any improvement over the figures for surface roughness there given. The claimed Si and Al contents were not suggested in any cited document, nor was there any indication that it was important for the MnS particles not to be associated with oxides. In accordance with the decision T 175/84 (OJ EPO 1989, 71) the non-obviousness of a combination turned on the simultaneous presence of all of its features. Here, the cited documents each disclosed some, but not all of the claimed features.

V. With its grounds of appeal the Appellant filed a first auxiliary request introducing minimum levels for Si and Al respectively of 0.001% and 0.0005%, and a second auxiliary request which included the same minimum limits, while identifying the manganese sulphide-base inclusion as being associated with one or more of Al_2O_3 , SiO_2 and MnO.

VI. The Respondents argued that the alleged invention lacked novelty in the light of the disclosure of document T1. As to the Appellant's attempt to rely on the distinction between machinability and surface roughness, it was to be seen that document T1, which was one of the Appellant's own earlier publications, showed in Figure 19 that improved surface roughness was associated with round rather than elongated particles of MnS. That figure showed that improved surface quality was regarded by the Appellant as being but one aspect of machinability. In fact all the proposals of the patent in suit said to be directed to the goal of improving the surface quality were exactly those proposed in the past for the improvement of

machinability. As was correctly observed by the Opposition Division, each of documents document T1, T4, T5 and U1 pointed in the same direction, towards minimising the contents of oxides, Si and Al.

The issue was not whether the patent in suit was directed to the same or a different goal from those of the cited prior art, but rather whether the patent in suit taught the skilled reader anything different from what had been taught in the past. The fact that an old teaching had an effect which went beyond those hitherto recognised did not make the old teaching new. Annex A, a document attached to the letter dated 15 March 1994 from the Respondent OI, showed that the composition now claimed fell wholly within the disclosure of document T1. That applied to the size of the MnS inclusions, as well as to the contents of oxides, Si and Al. The use of flushing with argon gas was a well known technique which the skilled person would introduce in a case such as the present, to achieve homogenisation of the melt, particularly in the presence of a heavy element such as lead, and to remove oxide inclusions such as alumina or silica into the slag. The claimed maximum level of 0.0009% of Al was theoretical in that it was below the practical limits of analysis normally available in steel making.

In the teaching of document T1 there was a clear pointer towards keeping the levels of Si and Al as low as possible, while document U2 showed that a steel with 0.007% Si had notably worse free-machining properties than one with 0.001% Si. In the light of the whole of the cited literature there could be no doubt that the Opposition Division had reached a correct decision in revoking the patent.

VII. The Appellant requested that the decision under appeal be set aside, and the patent maintained as granted (main request) or on the basis of set one or set two of the Claims filed with the Statement of Grounds of appeal (1st and 2nd auxiliary requests. The Respondents requested that the appeal be dismissed.

Reasons for the Decision

1. The appeal is admissible.

2. *The alleged invention*

2.1 The nature of the conference identified in connection with document T1 above, and the cited documents directed specifically to the problems associated with free-cutting continuous-cast steels, show that this was a very active field of research in the mid-1980's when the alleged invention was made. Although Claim 1 identifies numerous features, most of them are the commonplace features expected by the skilled worker for a free-cutting steel. Consequently, the argument in the present appeal centred on whether the distinguishing features, in particular the low levels for both Si and Al, would have been obvious to the skilled worker.

2.2 Although the patent in suit emphasises at page 2 lines 27 to 29 that its objective is not just to secure an improved tool life during machining, but also to secure better surface smoothness in the machined products, as the means for securing the desired surface smoothness are in fact the same as those used in the past, and as it is the common goal of those producing free-cutting steels to achieve both improved tool life, and improved surface smoothness, the Board is satisfied that these two objectives go hand-in-hand, and that the

skilled worker would expect both to be improved by the same means. Furthermore, if the means adopted in accordance with the alleged invention achieves the desired goal, the same effect must have been achieved in the past by the use of the same means.

2.3 Of the many integers of Claim 1 in suit, the majority define the well known compositions of free-cutting steels. Discussion centred on the allegedly distinctive features: i.e.

- (a) O: 0.010 - 0.020 = 100 - 200 ppm
- (b) Si: 0.003 or less
- (c) Al: 0.0009 or less, and
- (d) MnS particles having a mean sectional area of not less than $30 \mu\text{m}^2$ (preferably $100 \mu\text{m}^2$ or more in Claim 6).

Although Claim 1 identifies a further feature concerning the association of the MnS with oxides, it was accepted throughout by the Appellant that that feature would be satisfied by the low oxide content resulting from the low proportions of O, Si and Al.

3. *The prior art*

The five documents, T1, T4, T5, U1, and U2 mentioned above were discussed in detail during the appeal.

3.1 Document T1, published by a group of workers in the Appellant company, which includes one of the co-inventors, is concerned with continuous-cast free-cutting steel. It discloses in particular at page 141 (left column, first full paragraph) the need for achieving relatively large non-elongated particles of MnS, which are known to act as a lubricant during machining, and to prevent build-up on the surface of the cutting tool, and also the need for low oxide contents (cf. also Figures 5, 6, and 7, as well as

Figures 18 and 19 discussed on page 142). At page 142 in the penultimate paragraph there is reference to the undesirability of oxides, such as aluminates and silicates. This discloses all the features of Claim 1 in suit, save that there is no explicit mention of the low levels of Si and Al which feature in Claim 1. Although it was argued that Table 1 on page 144, which discloses a composition having no Al, and Si at a level of ≤ 0.015 , overlaps with and thus discloses a composition falling within Claim 1, the Board does not regard it as sufficiently detailed to deprive Claim 1 of novelty. The level of Si permitted by document T1 is five times higher than the maximum specified by Claim 1 in suit. Nonetheless, this document discloses features (a) and (d) of Claim 1, and it points towards features (b) and (c).

3.2 Document T4 is also concerned with continuous cast steels of various types, including free-cutting steels (at page 1157). It discloses argon stirring to homogenise the melt (page 1155 right column, also Figure 1, and page 1156 left column 5th paragraph, and in connection with free-cutting steels at page 1157). At page 1157 in the left column reference is made to the need to control the oxygen content of free-cutting steels, and its relationship to the amounts of Si and Al, suggesting that the steels should be free of these elements ("wobei eine Si- und Al-freie Stahlanalyse sichergestellt wird."). Although it was argued that those words amount to a disclosure of the low levels of Si and Al now claimed, the Board does not accept that argument, but holds nonetheless that there is a strong pointer in the direction of very low contents of these two elements. T4 is therefore held to disclose feature (d), and to contain strong pointers towards features (a), (b) and (c).

3.3 Document T5 is specifically directed to continuous-cast free-cutting steels. It teaches the avoidance of Si and Al (page 77 right column point 2.1), the inclusion of 100 - 200 ppm of oxygen (page 78 right column and Figures 3 and 9) which is exactly the same as the 0.010 - 0.020% of Claim 1 of the patent in suit, the desired shape and size of the sulphide particles (page 79 point 2.3). There is no explicit disclosure of the low level of Al claimed. Features (a) and (d) are disclosed, while there is a pointer towards features (b) and (c).

3.4 Document U1 is a further review article directed to continuous-casting of free-cutting steels. At page 181, point 3.1, reference is made to the avoidance of Si and Al as deoxidisers. The desired oxygen content is expressed as 100 to 200 ppm at page 182 (left column first paragraph, and under 4.1 in the right column; see also Figures 2, 7 and 8). The desired shape and size of the sulphide inclusions is discussed in point 3.3 on page 182, where reference is made to Figure 6. At Table 1 on page 184 a steel composition is disclosed (so far as concerns only the elements C, Si, Mn ["Mr" seems to be a misprint] S, and Al) but it is significant that the elements Si and Al are indicated as being present only in trace quantities. The production process used is described briefly in these terms, "Figure 1 shows the production process". That Figure shows an LD converter followed by a step identified as "Ladle Bubling". In the absence of any further description, the Board interprets that step as involving bubling with an inert gas such as argon, for the known effects of stirring and removing oxides and other non-metallic inclusions.

Features (a) and (d) are disclosed. The Appellant argued regarding features (b) and (c) that the disclosure of only trace amounts of Si and Al left open the magnitude of the trace. That is accepted, but there is no escaping the fact that this disclosure is yet another strong pointer towards very low levels of these two elements.

3.5 Document U2, published in 1967 well before some of the other prior art considered, is concerned with the effect of oxygen in resulphurised (i.e. free-cutting) steels. Table 1 lists compositions based on experimental batches of 100 pounds of steel made up using electrolytic iron. Thus, where in steels 1, 2, and 3 of Table 1 it is indicated that no deoxidant was used, and that Si was present at a level of 0.001% and there is no indication of any Al at all, it may be taken that Al was actually absent. Steels 8 and 9 containing acid soluble Al at levels of 0.003% and 0.009% are shown in Fig 1 to have a significantly lower machinability index. The total oxygen contents of the steels having no deoxidiser are shown in Table II on page 32 to be above the limits set by Claim 1. Thus steels 1 to 3 of Table 1 disclose features (b), (c) and (d) of Claim 1 in suit, but lack feature (a).

4. *Novelty*

From the above description of the main prior art documents it follows that their disclosures do not deprive the subject-matter of Claim 1 in suit of novelty. As the other documents cited are still more remote, it follows that there is no disclosure of a continuous-cast free-machining steel having all the features of Claim 1. Its subject-matter is therefore considered novel for the purposes of Article 54 EPC.

5. *Inventive step*

Main request

The Board agrees with the Opposition Division in regarding document T1 as the closest prior art. It is a document emanating from the Appellant shortly before the priority date of the patent in suit, and is concerned with substantially the same problems, i.e. the attainment of good free-cutting properties in continuous-cast steels. As indicated above, this document discloses all the features of Claim 1 in suit, save that it points to, but does not disclose, features (b) and (c), the low levels of Si and Al. There are similar pointers in each of documents T4, T5, and U1, and an actual disclosure of levels of Si and Al falling within the claimed limits in U2. Accordingly the Board agrees with the Opposition Division that, given the disclosure of document T1, and seeking to produce optimum qualities in a continuous-cast free-cutting steel, the skilled worker would establish by trial and error the optimum level to which the proportions of Si and Al ought to be reduced in order to achieve the desired free-cutting properties. That kind of routine experimentation would not entail any inventive step, and would lead to a composition falling within the claimed range.

The auxiliary requests

Each of the Claims 1 in accordance with the auxiliary requests introduces for the first time a minimum level for Si and Al contents, i.e. the presence of these elements is actually required. However, the description of the patent in suit is fully consistent with the prior art discussed above in recognising that, in these free-cutting steels, Si and Al are undesirable impurities whose presence should be kept to a minimum.

Nowhere in the description is there any suggestion that a minimum trace amount of these elements could provide any useful effect. It follows that the proposed amendments offend against Article 123(2) EPC by introducing subject-matter not disclosed in the application as filed. The auxiliary requests must therefore be refused. For the sake of completeness it is added that, given the closeness of the alleged invention to the prior art, it would be difficult to contemplate any subject-matter included in the patent in suit which could have been the basis for an acceptable auxiliary request.

6. *Conclusion*

Claim 1 of the patent in suit, in accordance with the main request, lacks any inventive step, and therefore fails to satisfy the essential requirement of Article 56 EPC. The Claims 1 in accordance with the two auxiliary requests fail to meet the requirements of Article 123(2) EPC, and are therefore inadmissible.

Order

For these reasons it is decided that:

The appeal is dismissed.

The Registrar:



S. Fabiani

The Chairman:



H. Seidenschwarz



