Internal distribution code:
(A) [ ] Publication in OJ
(B) [ ] To Chairmen and Members
(C) [ ] To Chairmen
(D) [X] No distribution

D E C I S I O N
of 20 June 2006

Case Number: T 0450/04 - 3.2.02

Application Number: 00100109.8

Publication Number: 1020539

IPC: C22C 38/58

Language of the proceedings: EN

Title of invention:
Super-high-strength line pipe excellent in low temperature toughness and production method thereof

Applicant:
NIPPON STEEL CORPORATION

Opponent:
-

Headword:
-

Relevant legal provisions:
EPC Art. 123(2), 56

Keyword:
-

Decisions cited:
T 0201/83

Catchword:
-

Case Number: T 0450/04 - 3.2.02

D E C I S I O N
of the Technical Board of Appeal 3.2.02
of 20 June 2006

Appellant: NIPPON STEEL CORPORATION
6-3, Otemachi 2-chome
Chiyoda-ku
Tokyo 100-8071 (JP)

Representative: Vossius & Partner
Siebertstrasse 4
D-81675 München (DE)

Decision under appeal: **Decision of the Examining Division of the European Patent Office posted 14 November 2003 refusing European application No. 00100109.8 pursuant to Article 97(1) EPC.**

Composition of the Board:

Chairman: T. K. H. Kriner
Members: R. Ries
E. Dufrasne

Summary of Facts and Submissions

I. This appeal is against the decision of the examining division posted 14 November 2003 to refuse European patent application 00 100 109.8.

The ground of refusal was that claim 1 of the main request and auxiliary requests 2 to 6 then on file either did not involve an inventive step or were objectionable under Article 123(2) EPC, respectively. Reference was made in the decision, amongst others, to the following documents:

D1: Patent Abstracts of Japan volume 1999, no. 02, 26 February 1999 & JP-A-10 306347 (NIPPON STEEL CORPORATION), 17 November 1998

D2: Patent Abstracts of Japan volume 1999, no. 02, 26 February 1999 & JP-A-10 306348 (NIPPON STEEL CORPORATION), 17 November 1998

In the decision under appeal, the examining division reasoned with particular reference to document D1 that the composition of the steel plate was known, since the carbon content of the known steel plate alloy could be as low as 0.05% and the ranges of the other alloying elements were either identical with or fell within those of the claimed steel. Moreover, the composition of the weld bead known from D1 was considered to overlap with the claimed ranges and provided the same effect. The division further acknowledged that document D1 did not explicitly disclose a carbon content as low as 0.04% set out in claim 1 of auxiliary request 6, but reasoned that the effects provided by a lower carbon content on the microstructure (the martensite/bainite ratio), the formability as well as the toughness and strength were well known to the skilled practitioner. Hence, nothing inventive was found in the limitation of the carbon content to the singular value of 0.04% set out in claim 1 of auxiliary request 6.

II. On 12 January 2004 the appellant (applicant) lodged an appeal against the decision and paid the prescribed fee on the same day. A statement setting out the grounds of appeal was filed on 24 March 2004. Together with this statement, the appellant submitted a main request, a first and second auxiliary request. Oral proceedings were requested in case the board did not allow the claims according to the main request.

III. In order to meet the appellant's request, the appeal board issued a summons to oral proceedings expressing doubts that the amendments to claim 1 according to the main request met the requirements of Article 123(2) EPC. The objection under Article 123(2) EPC arose in defining an upper limit of 0.05% for the carbon range of the claimed steel alloy. The appellant's attention was also drawn to documents D1 and D2 which were considered highly relevant to the subject matter claimed in the application.

IV. With the appellant's response, translations into English language of documents D1 and D2 were enclosed which are in following enumerated as documents D1a and D2a.

V. Oral proceedings were held on 20 June 2006. The appellant requested that the decision under appeal be set aside and a patent be granted on the basis of the claims according to the main request or, in the alternative, on the basis of any of the auxiliary requests 1 and 2, in that order and all filed at the oral proceedings.

VI. Claim 1 of the main request reads as follows:

"1. A super-high-strength line pipe produced by a U & O process comprising the steps of shaping a base metal steel plate into a U-shape and then O-shape and submerged arc welding, said pipe having a weld metal excellent in low temperature toughness at inner and outer surfaces of its seam portions, wherein said steel plate comprises, in terms of wt%,

C: 0.04 to 0.05%,
Si: not greater than 0.6%,
Mn: 1.7 to 2.5%,
P: not greater than 0.015%,
S: not greater than 0.003%,
Ni: 0.1 to 1.0%,
Mo: 0.15 to 0.60%,
Nb: 0.01 to 0.10%,
Ti: 0.005 to 0.030%, and
Al: not greater than 0.06%,

and contains selectively at least one of the following elements;

B: not greater than 0.0020%,
N: 0.001 to not greater than 0.006%,
V: not greater than 0.10%,
Cu: not greater than 1.0%,
Cr: not greater than 0.8%,
Ca: not greater than 0.01%,

REM: not greater than 0.02%,
Mg: not greater than 0.006%,
and the balance being Fe and unavoidable impurities,

and the submerged arc weld metal of the pipe contains, in terms of wt%,
C: 0.04 to 0.14%,
Si: 0.05 to 0.4%,
Mn: 1.2 to 2.2%,
P: not greater than 0.010%,
S: not greater than 0.010%,
Ni: 1.3 to 3.2%,
Cr+Mo+V: 1.0 to 2.5%,
B: not greater than 0.005%,
and the balance being Fe and unavoidable impurities, and the Ni content of the weld metal is higher by at least 1% than the Ni content of the base metal steel plate, and wherein the tensile strength of the pipe at the base metal steel plate portion in a circumferential direction is from 900 to 1,100 MPa, and the mean tensile strength of the weld metal is at least the tensile strength of the steel plate - 100 MPa."

Claim 1 of the first auxiliary request differs from the main request in that the carbon content of the steel plate is restricted to the singular value of "**C: 0.04%**".

Claim 1 of the second auxiliary request complies with claim 1 of the first auxiliary request and further includes the wording ...Mg: not greater than 0.006%, **wherein Ni amount is at least 1/3 of Cu amount** and the balance being Fe and..."

VII. The arguments of the appellant in support of the appeal can be summarised as follows:

The strength of the base metal steel plate was exclusively determined by the level of the carbon content as reflected by paragraph [0012] of the A2 publication of the application. This finding was supported by the examples A to D given in Table 1 where carbon varied from 0.04 to 0.07% while the amounts of the other components remained almost unchanged. Although the correlation rule for the hardenability index $P = 2.7C + 0.4Si + Mn + 0.8Cr + 0.45(Ni+Cu) + (1+\beta)Mo - 1 + \beta$ with $1.9 \leq P \leq 4.0$ included carbon, its influence upon P was small (in the range of about 1%) and thus could be neglected. Moreover, carbon did not interact with the other components of the claimed steel alloy so that no or only a loose connection existed with the other elements. For this reason, carbon could be considered separately. Following the considerations given in decision T 201/83, points 6 to 9, the carbon content of each example could be selected as an endpoint of a particular sub-range. Consequently, claim 1 of the main request satisfied the requirements of Article 123(2) EPC.

As to the issue of novelty, document D1a failed to disclose a carbon content ranging from 0.04% to 0.05% and the claimed requirement for the tensile strength (TS) stipulating that the mean TS of the weld metal should be at least the TS of the steel plate minus 100 MPa. Contrary to the increased amounts of oxygen ranging from 0.035 to 0.050% which, according to document D2, were crucial to prevent hydrogen cracking (cold cracking), the claimed weld bead comprised only residual amounts of oxygen in the weld zone in the order of those disclosed in the examples of document D1a. Novelty vis-à-vis the disclosure of D1a and D2a was therefore given.

Turning to the question of inventive step, documents D1a and D2a required the presence of at least 0.05% C or higher for securing a sufficiently high TS and low temperature toughness and thus dissuaded from reducing the carbon content of the base steel plate to the claimed range of 0.04 to 0.05% or to even 0.04%. Acting upon the teaching of both documents, the person skilled in the art would, therefore, have avoided carbon contents of 0.05% or lower. In addition, it was against the teaching of D2a to reduce the high oxygen content in the weld bead which was considered indispensable in this document to avoid hydrogen (cold) cracking. Thus, neither D1a nor D2a gave an indication the skilled person to produce the line pipe of the claimed composition which achieved an excellent match in high strength and low temperature toughness not obtained in the prior art before.

Reasons for the Decision

1. The appeal is admissible.

2. *Main request; Article 123(2) EPC*

According to claim 1 of the main request, the carbon range of the steel plate has been restricted to 0.04 to 0.05%. While the lower limit for carbon is unchanged, the upper limit of 0.05% C is derived from exemplifying alloy D disclosed in Table 3 of the application as filed.

Nothing however could be found anywhere in the application as filed for supporting this limitation of the carbon range, i.e. a martensitic-bainitic steel pipe comprising "not more than 0.05 wt% C" to improve the alloy's tensile strength, low temperature toughness, the U-O formability or the pipe's resistance to cracking during expansion. Paragraph [0012] and the examples A to D in Table 1 of the application (see the A2-publication) teach the skilled reader that the target strength and the low temperature toughness in the martensite/bainite steel pipe are successfully obtained by adhering to a carbon content ranging from 0.04 to 0.10% C or, more preferably, from 0.04 to 0.08% C. This is confirmed by the examples A to D, exhibiting carbon contents of 0.06%, 0.07%, 0.04% and 0.05%.

It is clear to the metallurgist that the overall properties of a steel alloy are generally brought about by the interaction of **all** the constituents thereof. This means that the individual amounts of C, Si, Mn, Cr, etc featuring in a specific example are tied to the amounts of the other components Ni, Cu, Mo, B etc to promote the formation of the desired microstructure and to provide the mechanical properties including the tensile strength, toughness and hardenability. In the present application, the latter property is expressed by the hardenability index $P = 2.7C + 0.4Si + Mn + 0.8Cr + 0.45(Ni+Cu) + (1+ \beta) Mo - 1 + \beta$ (cf. paragraph [0029] of the A-publication) whereby the relation $1.9 \leq P \leq 4.0$ is to be satisfied. Contrary to the appellant's position, this correlation rule describes an interrelationship between the enumerated components in that a particular choice of a level for one (or several) element(s) restricts the amount(s) of the other element(s), if substantially the same result is to be achieved. The influence of carbon on the hardenability may be small, as alleged by the appellant, but nevertheless exists.

It is further evident from the description that carbon not alone, but in combination with other components such as V, Cu, Cr contributes to improving the tensile strength of the steel alloy and to promoting the formation of the desired martensite/bainite structure altogether with manganese and molybdenum and by using the appropriate production conditions (cf. paragraphs [0012], [0014], [0016], [0023], [0030]).

Given this situation, the individual amounts of the constituents of the exemplifying alloy D or any other example are not allowed to be regarded in strict isolation. This may be done only in very exceptional cases. Reference is made in this context to decision T 0201/83 (lead alloy) where the Board first established that, for a given Pb-alloy, only a loose or no connection existed between the components Ca and Mg with regard to their effect and that the actual amount of Ca was **not** tied to a specific magnesium content. From the detailed considerations given in T 0201/83 the conclusion must be drawn that because of the effects of interaction of the constituents making up the claimed martensitic-bainitic steel composition and its properties, it is not possible to make an arbitrary selection of individual features from the single examples. To disregard the specific context would result in a new selection from the original range which was neither explicitly nor implicitly disclosed. This means that the above decision does not allow any arbitrary combination of values, isolated from the original text.

It is therefore concluded that the limitation in claim 1 of "0.04 to 0.05 wt% C" represents an arbitrary selection rather than a preferred embodiment that was originally disclosed for the martensitic bainitic steel composition. Claim 1 according to the main request therefore contravenes the requirements of Article 123(2) EPC.

3. *Auxiliary requests 1 and 2; inventive step*

3.1 Document D1a discloses a welded ultrahigh strength steel pipe formed by the U-O-E process exhibiting a TS of 950 N/mm^2 or more and an excellent low temperature toughness. (cf. D1a, abstract, paragraph [0004] and Table 2). The steel pipe is made from a low C - high Mn-Nb-Mo-Ti-based matrix metal and comprises a low C-Mn-Ni-Cr-Mo-low oxygen based welded metal. In the matrix metal, carbon may be as low as 0.05% to provide sufficient strength, and the other alloying elements are within or identical with the claimed ranges (cf. D1a, claims 1 to 4). To prevent crack formation during continuous casting due to the presence of Cu in the melt, Ni is added in an amount of 1/3 or more of the amount of Cu (cf. D1a, paragraph [0033]. The composition of the weld zone broadly overlaps with the claimed ranges (cf. D1a, paragraphs [0012] to [0029]).

Particular reference is made to Table 1, example 1 disclosing the compositions of the matrix and the welded metal which - except for 0.056% C of the matrix - both fall within the ranges defined in claim 1 of the auxiliary request. D1 does, however, not disclose the TS and YS of the weld metal.

3.2 The claimed welded steel pipe set out in claim 1 of the first and second auxiliary requests differs from this prior art (a) by a carbon content of 0.04% in the matrix and (b) by the mean TS of the weld metal that is to be at least the TS of the steel plate - 100 N/mm^2.

As to feature (b), reference is made to document D2a, claims 1 to 4. Except for the oxygen content which in the welded metal part of the pipe has been raised to 0.035 to 0.050% for reducing the crack susceptibility due to hydrogen (cf. D2a, paragraph [0009], the composition and production route of the ultrahigh strength steel pipe in D2a comply with those described in document D1a. All examples 1 to 4 given in Tables 1 and 2 of document D2a exhibit a TS of the weld zone that is somewhat above that of the steel pipe matrix (cf. e.g. D2a, sample 1, TS_{matrix} = 1015 N/mm^2 - $TS_{welded\ zone}$ = 1022 N/mm^2) and therefore meet the claimed criterion. Nothing is discernable from the disclosure of D2a that the increased oxygen content in the welded metal adversely affects or improves the tensile strength in the welded material(see in this context also D2a, Tables 1 and 2, comparative example 10, comprising only 177 ppm oxygen). Given the close similarity of the examples in documents D1a and D2a, it can be concluded that feature (b) is likewise satisfied by the examples disclosed in document D1a.

Turning to feature (a), document D1a mentions in paragraph [0030] that carbon is extremely effective for securing the strength of the matrix metal and, therefore, a minimum content of 0.05% C should be adhered to. The paragraph further reflects that the TS of the matrix metal improves with higher carbon contents as the amount of martensite in the microstructure is increased, whereas the low temperature toughness impairs. As set out in document D1a, a suitable compromise between strength and toughness is achieved by selecting a carbon content in the range of 0.05 to 0.10% in the matrix metal. This carbon range essentially complies with that described in paragraph [0012] of the present application as originally filed (0.04 to 0.10% C). All the effects of carbon on the TS, toughness and the microstructure are well known to the skilled metallurgist. The fact that document D1 proposes a limit of 0.05% C merely results from the specific balance TS/low temperature toughness aimed at by this document. It is however part of the activities of a skilled metallurgist to optimise, if necessary, a given balance of properties for a particular steel. It, therefore, does not involve an inventive step to reduce the carbon content to 0.04% instead of 0.05% if a lower TS together with an improved toughness i.e. a slightly different but still acceptable compromise between two effects which are contingent in opposing ways is aimed at. Consequently, nothing inventive can be found in shifting the carbon content to 0.04% C.

4. It is therefore concluded that claim 1 according to the first and second auxiliary requests does not comprise

technical subject matter which gives rise to patentable matter.

Order

For these reasons it is decided that:

The appeal is dismissed.

The Registrar:	The Chairman:
V. Commare	T. K. H. Kriner