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File Number: T 839/90 - 3.3.3
Application No.: 80 104 707.7
Publication No.: 0 027 510
Title of invention: Bismuth containing steel

Classification: C22C 38/60

DECISION
of 2 April 1992

Proprietor of the patent: INLAND STEEL COMPANY

Opponent: Thyssen Stahl AG
British Steel plc

Headword:

EPC Articles 54 and 56

Keyword: Disclaimer of prior art permitted, but disregarded in evaluating
inventive step
"Inventive step - no"

Headnote



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Boards of Appeal

Chambres de recours

Case Number : T 839/90 - 3.3.3

D E C I S I O N
of the Technical Board of Appeal 3.3.3
of 2 April 1992

Appellant :
(Proprietor of the patent)

INLAND STEEL COMPANY
30 West Monroe Street
Chicago, IL 60603 (US)

Representative :

Leach, John Nigel
FORRESTER & BOEHMERT
Franz-Joseph-Strasse 38
W - 8000 München 40 (DE)

Respondent :
(Opponent 01)

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

Representative :

Cohausz & Florack
Patentanwälte
Postfach 14 01 61
Schumannstrasse 97
W - 4000 Düsseldorf 1 (DE)

Respondent :
(Opponent 02)

British Steel plc
9 Albert Embankment
London SE1 7SN (GB)

Representative :

Broughton, Clifford David
British Steel plc
Patent Section
9 Albert Embankment
London SE1 7SN (GB)

Decision under appeal :

Decision of Opposition Division of the European
Patent Office of 3 July 1990, issued 16 August
1990, revoking European patent No. 0 027 510
pursuant to Article 102(1) EPC.

Composition of the Board :

Chairman : F. Antony
Members : R.A. Lunzer
M.K.S. Auz Castro

Summary of Facts and Submissions

- I. European patent No. 0 027 510 was granted on 19 October 1983 on the basis of application No. 80 104 707.7, filed on 11 August 1980, having a priority date of 29 August 1979, derived from US Application No. 70669.
- II. Oppositions to the patent were lodged respectively by the first and second Respondents on 30 June, and 9 July 1984, on the grounds of Article 100(a) and (b) EPC, alleging lack of novelty (Article 54 EPC), lack of inventive step (Article 56 EPC), and lack of sufficiency of disclosure (Article 83 EPC).
- III. By a decision of 8 October 1986, issued on 7 January 1987, the Opposition Division revoked the patent on the ground of lack of novelty, having regard to the prior disclosure of the alleged invention by documents sent to a third party in connection with sales of steel by the second Respondent. The analyses given in the said documents showed that three batches of the steel included nitrogen levels respectively of 0.010%, 0.008%, and 0.009%. The compositions of those steels fell within Claim 1 as granted, which was in the following terms:

"A free machining cast steel shape characterised in that said shape comprising of, in wt.%,

carbon	0.06 to 1.0
manganese	0.3-1.6
silicon	0.30 max.
sulphur	0.03-0.50
phosphorous	0.12 max.
bismuth	0.05-0.40
lead	0-0.30
tellurium	0-0.06
iron	essentially the balance,

and wherein:

the total amount of ingredients which lower the wetting ability of bismuth is less than the bismuth content of said steel."

- IV. There was an appeal by the patentee against that decision. By its decision T 105/87 of 25 February 1988, Board of Appeal 3.3.1 held that a claim amended by express disclaimers of each of the above-mentioned point values of nitrogen content overcame the objection of lack of novelty. It made no finding on the issue of inventive step, which it referred back to the Opposition Division under Article 111(1) EPC.
- V. In the course of resumed proceedings before the Opposition Division, the second Respondent introduced for the first time document:

- (6) Confirmation dated 5 March 1979 of order No. 09-437WW/70391.

This was a letter sent to the purchaser of the above mentioned steels which described one of them as containing nitrogen in the range of 0.006 to 0.011%. Reference was also made by the Opposition Division to the documents which had been cited during the initial opposition period, including the following:

- (2) Drahtwelt 59 (1973), No. 8, p. 347-352
- (5) Invoice, order No. 09-437/WW/70391, cast No. 16871
- (7) United States Steel, prospectus: Mach-5 Free-Machining Steel (June 1969) pp. 1-15

(8) US-A-2 378 548, and

(10) British Steel Co. Report No. Tech/Misc/132/76/A
(1976), pp. 1-3 which was complemented by 25 tables.

VI. With a view to meeting the impact of document (6), the Appellant filed as its main request in the opposition an amended Claim 1 which was in the same terms as Claim 1 as granted, except that at the end of the claim, after the words, "said steel", the following disclaimer was added:

"; and excluding steel containing 0.006% or more nitrogen".

There were also four auxiliary requests, in accordance with the last of which Claim 1 was the same as Claim 1 of the main request, save that the bismuth range was limited to 0.05 to 0.20%.

VII. By its decision given in writing on 16 August 1990, the Opposition Division held that although it was prepared to allow the introduction of an upper limit of nitrogen of 0.006% by way of express disclaimer of prior art, it was not willing to allow the introduction into the claims of the word "un-renitrogenised", and as that word had been introduced into Claim 1 or Claim 2 in each set of claims making up the five requests, it followed that none of the requests related to an admissible set of claims.

Regarding novelty, it was held that the subject-matter of Claim 1 in accordance with the main request lacked novelty because a skilled worker, making alloys in accordance with the teachings of document (7) or document (8), would normally use the hot metal route for steel making, in accordance with which the level of Cu, Ni, and Sn

(hereinafter the "residual elements") would be at a level of 0.07% or less, which was below the bismuth content contained in the disclosed steels. It was held further that even assuming in the Appellant's favour that the alleged invention were to be novel, it was nonetheless lacking in any inventive step, taking into account the teachings of documents (7) or (8), when read in the light of documents (2) or (10).

VIII. An appeal against that decision was lodged on 10 October 1990, the appeal fee was paid on the same day, and the Grounds of Appeal were filed on 10 December 1990. In the Statement of Grounds of Appeal, and during oral proceedings held on 2 April 1992, the Appellant argued that it had made an important advance in the art of the production of bismuth containing free machining steels by identifying for the first time the mechanism by which bismuth improves the free machining properties of steels, viz. by the effect of liquid metal embrittlement, and had identified the elements which tend to raise the surface free energy value of the liquid metal embrittler as being Cu, Ni, Sn, and Zn. On the basis of that new understanding, it taught for the first time that these elements need to be kept at a level below the proportion of bismuth in order not to mask the desirable effect of bismuth.

IX. The Respondents argued that there was no useful advance in the art disclosed, because the amount of residual elements normally found in steels is relatively small, and below most of the claimed range of bismuth to be added. Accordingly, a skilled worker making a steel in accordance with the compositions disclosed in documents (6), (7) or (8) would follow ordinary good steel making practice, and would keep the level of residual elements low, so that their proportion would be below the level of added

bismuth. The alleged invention was therefore lacking in novelty, or alternatively lacking in any inventive step.

- X. The Appellant (patentee) requested that the decision under appeal be set aside, and that the patent be maintained on the basis of the main request, or one of the four auxiliary requests as they were before the Opposition Division, subject to amending the words "no more than 0.005% nitrogen" to "less than 0.006% nitrogen" wherever they occurred in the claims. The Respondents requested that the appeal be dismissed.

Reasons for the Decision

1. The appeal complies with Articles 106 to 108 and Rule 64 EPC, and is admissible.
2. Admissibility of Amendments
 - 2.1 Claim 1 in accordance with the main request corresponds to Claim 1 as granted, subject to the addition of the disclaimer in the words - "excluding steel containing 0.006% or more nitrogen". Although there is no mention of nitrogen content of steels in accordance with the alleged invention in the application as originally filed, this relatively high level of nitrogen was achieved in the case of the alloys disclosed in documents (5) and (6) by a step of renitrogenisation. Therefore, although the patent in suit is wholly silent on the issue of nitrogen content, these words may be introduced as a specific disclaimer of prior art in accordance with established jurisprudence; see, e.g., T 04/80, "Polyether polyols/BAYER", OJ EPO 1982, 149, and T 433/86 of 11 December 1987 (not published in OJ EPO).

2.2 Furthermore, for the same reason, the Board can see no valid objection to the introduction of the word "unrenitrogenised", which is to be found in Claim 2 in each of the main request, the first auxiliary request, and the fourth auxiliary request, and Claim 1 of the second and third auxiliary requests.

3. The description of the alleged invention

3.1 The opening paragraph of the patent in suit (page 3, lines 1 to 3) indicates that the alleged invention lies in the realm of enhancing the ability of bismuth to act as a liquid metal embrittler. The following paragraphs in lines 4 to 41 contain a theory that bismuth improves machinability because of its liquid embrittling effect, which in turn depends on its having a relatively low melting point, being liquid at the temperature prevailing at the tip of the microcrack during machining, and also has a relatively low surface free energy value near its melting point, enabling it to wet a relatively large surface area along grain boundaries or interphase boundaries. Consequently, anything which raises the surface free energy value is undesirable. This point is amplified at page 4, lines 12 to 27, which, together with the statement on the same page at line 65, identifies the elements which lower the wetting ability of bismuth, and therefore have a deleterious effect on the free machining qualities of the steel, as being Cu, Ni, Sn, and Zn, it being explained that Zn can be left out of account because it is not normally found in steels.

3.2 The correctness of that theory was challenged by the second opponent, in particular in its reply statement in the Opposition filed on 1 October 1985, which was

supported by the statement by Dr. Naylor*, purporting to demonstrate that the theory was wrong.

- 3.3 For present purposes, the Board is prepared to make the assumption in the Appellant's favour that the theory may be correct, and that the Appellant could have made a useful discovery in having found that, provided the level of bismuth is above the level of residual elements, better free cutting steels are made than when it is below that level.

4. Closest prior art

The Board regards document (8) as being the closest prior art. It was published in 1945, and relates to the discovery that bismuth may advantageously be added to free machining steels in a proportion of 0.01 to 1.0%. In column 2 on page 1, examples of bismuth containing steels are given, there being six examples in Table I, out of which four have bismuth contents of 0.06 to 0.38%, while fourteen out of the sixteen examples shown in Table II contain bismuth in the range of 0.045 to 0.143%, and a generally higher proportion of sulphur. Tables I and II each contain two examples in which bismuth is absent, so as to demonstrate the beneficial effect of the presence of that element on the free machining properties of the steel, in Table I by showing reduced tool force, and in Table II by showing improved cutting speeds. Thus, this prior document teaches the general usefulness of bismuth

* departmental manager in the Special Carbon Steels Group of the second Opponent, specialised in machinability testing and development of free machining steels

additions in free machining steels when added in proportions covering the whole of the range now covered by Claim 1.

5. Novelty

5.1 The alleged invention differs from the disclosure of document (8) only to the extent that Claim 1 specifies a lower proportion of residual elements than bismuth, while document (8) is silent on that topic. In attacking the novelty of the alleged invention, the Respondents relied on the disclosure of document (10), which reported on the proportions of residual elements found by the Second Respondent in its steels in 1976. There is no evidence of any publication of that document to a third party, but the Board treats it as being good evidence of the levels of residual elements which are normally to be found in steels, because the assertion by the Respondents that the values are typical is unchallenged by the Appellant.

5.2 Table 25, on the last page of document (10) summarises the figures for residual elements contents contained in earlier tables in the document, and the Board in its turn summarises the effect of Table 25 by observing that for steels made in oxygen blown converters using the hot metal route, i.e. without any additions of scrap, the average level of residual elements was 0.066%, whereas in steels made by the basic open hearth furnace, in which scrap was added, the average level was 0.225%.

5.3 Comparing the bismuth level of up to 0.10% disclosed in document (7), with the above-stated expected levels of residual elements, the Respondents argued that as document (7) disclosed a low proportion of nitrogen, 0.003 to 0.006%, which was consistent only with steel making conditions in which no scrap additions were made, i.e., by

using the hot metal route, the level of residual elements would in that case be below the level of bismuth. In the Board's view a similar attack could be based on the disclosure of document (8), the claims of which cover a bismuth content of 0.01 to 1.0%, and the examples of which cover the range 0.045 to 0.38% bismuth. In fact the highest level of residual elements disclosed in Table 25 of document (10), where scrap is added to 0.396% at the Glengarnock steel works, which figure is itself an average based on the data given in Table 21, which includes period 8 during which the level of residual elements was 0.401.

- 5.4 In summary, while the patent in suit claims bismuth contents in the range of 0.05 to 0.40%, which contents must be above the content of residual elements, the uncontested evidence before the Board is that normal levels for residual elements are in the range of about 0.06 to a maximum of 0.40%, depending on the steelmaking process used.
- 5.5 To establish lack of novelty, it does not suffice to show a high degree of probability that the practice of the teaching contained in a prior art document would have the effect of falling within the scope of the claim in suit. In the absence of literal disclosure, an inevitable result must be shown. Here, although it appears to be very likely that the performance of the examples of documents (7) or (8) using the hot metal route would result in the content of residual elements being below the level of bismuth, it was common ground that the hot metal route was not the only method of steel making, and that when scrap is added, higher levels of residual elements could result, and these could in some circumstances be above the bismuth levels.
- 5.6 Accordingly, as there is neither a disclosure of controlling the level of residual elements in documents

(7) or (8) to below the level of bismuth, nor is it an inevitable result that the level of the residual elements will be below the level of bismuth, novelty over these documents is established.

5.7 Novelty in relation to the alloys disclosed in documents (5) and (6) is achieved by the disclaimer of compositions with more than 0.0006% nitrogen. As none of the other cited documents is any more pertinent, the Board is satisfied that the alleged invention is novel.

6. Inventiveness

6.1 Taking into account the written submissions of the Appellant, the Board indicated at the outset of the oral proceedings that, although it was minded to allow the introduction of the disclaimer of more than 0.006% nitrogen, the nitrogen content of the steels in accordance with the alleged invention could not be regarded as relevant to the issue of inventiveness, because nitrogen content was not mentioned at all in the specification as filed, and a feature not originally disclosed cannot be the basis for a positive finding of inventiveness. In this connection the Board was applying in appropriate circumstances the general statement in T 170/87, Hot-gas cooler/SULZER, OJ EPO 1989, 441 (cf. point 8.4.4), to the effect that a disclaimer cannot be used to make an obvious teaching inventive.

7. Problem and its solution

On the premises set out in 3.3 above, the objective problem solved by the alleged invention may be seen to be the achievement of consistently good properties in free machining steels, it being assumed for the present purposes in the Appellant's favour, although not proved,

that free-machining steels having a composition falling inside the claim indeed have better properties than those with a higher proportion of residual elements.

8. Inventive step

8.1 Taking document (8) as a starting point, the issue of inventiveness turns on whether a skilled worker, confronted with the above defined problem, and applying the normal skills of the industry would have arrived at steels falling within the scope of Claim 1.

8.2 As is clear from document (10), the practice of the steel making industry, especially when using the hot metal route prevalent at the priority date of the patent, was intentionally to keep the proportion of residual elements low. To similar effect, and with particular application to free machining steels, is document (2), which at page 350 paragraph 6.12 teaches the undesirability of Ni and Cu (as well as Cr and Mo), in free machining steels of all types, because these elements cause unnecessary hardening, and thus lead to undue tool wear. The general undesirability of residual elements is also confirmed in the standard text-book of steel making, "The Making, Shaping and Treating of Steel", 9th Edn. (1971), United States Steel Corpn. cited by the Appellant during the opposition, which states at page 493:

"Residual alloy elements such as copper nickel or tin are usually considered undesirable in low-carbon steels because they adversely affect ductility."

8.3 Thus whether starting from document (8), or even if starting from documents (6) or (7), and applying to them the normal practice of the steel making industry as taught in any one of documents (2), (10), or the above mentioned

text-book, the skilled worker would normally arrive at the alleged invention, because the level of residual elements is normally kept low. The claimed upper limit of 0.4% for bismuth is high relative to commonly encountered levels of residual elements. Put in other words, the effect of maintaining the present patent would be to prevent the public from carrying out in a normal (but not the only possible) manner the teachings of documents (6), (7) or (8). The Board therefore concludes that the alleged invention is lacking in any inventive step.

- 8.4 The absence of any inventive step finds positive confirmation in the description contained in the patent in suit itself. At page 4, line 20 it states that the three residual elements are normally present in amounts up to about 0.1 wt. % each: i.e. that their normal total is 0.3%. Thus when bismuth is present in the upper part of the claimed range, from 0.3 to 0.4%, it is to be expected that, following what the patent accepts to be normal practice, the level of residual elements would normally be at or below the level of bismuth.

9. Auxiliary request

- 9.1 Claim 1 in accordance with the first auxiliary request is broader in its scope than Claim 1 in accordance with the main request, and therefore need not be considered separately.
- 9.2 Equally, although a minor difference in wording is observed, the Board does not regard the scope of Claim 1 in accordance with the second auxiliary request as being any different from that of Claim 1 of the main request.
- 9.3 In the third auxiliary request, the disclaimer of steels containing more than a specific percentage of nitrogen is

replaced by a disclaimer of re-nitrogenised steels. Effectively, the scope of the claim is therefore no different.

- 9.4 Finally, the fourth auxiliary request restricts the upper limit of bismuth to 0.2%. Making a comparison of the range of 0.05 to 0.2% bismuth with the normal level of residual elements of in steels made by the hot metal route of about 0.07%, it is evident that even with that reduced upper limit, the level of residual elements will fall below the level of bismuth over all but the lower extremity of the range of bismuth claimed. The Board is therefore satisfied that none of the requests covers any inventive subject-matter.

10. Conclusion

As the alleged invention lacks any inventive step, it fails to comply with the essential requirement of Article 56 EPC, and the patent must therefore be revoked.

Order

For these reasons, it is decided that:

The appeal is dismissed.

The Registrar:

The Chairman:

E. Goergmaier

F. Antony