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File No.: T 0650/90 - 3.2.2
Application No.: 86 901 940.6
Publication No.: 0 215 088
Classification: C21B 5/00
Title of invention: Improvements in or relating to ironmaking by means of
a smelting shaft furnace

D E C I S I O N
of 23 July 1993

Applicant: British Steel plc.
Proprietor of the patent: -
Opponent: -

Headword:

EPC: Art. 54, 56

Keyword: "Novelty (yes)" - "Inventive step (yes) - acting against
prejudice of the prior art; unexpected effect"

Headnote
Catchwords



Case Number: T 0650/90 - 3.2.2

D E C I S I O N
of the Technical Board of Appeal 3.2.2
of 23 July 1993

Appellant: British Steel plc.
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Representative: Heath, Peter William Murray
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Decision under appeal: Decision of the Examining Division of the
European Patent Office dated 12 February 1990
refusing European patent application
No. 86 901 940.6 pursuant to Article 97(1) EPC.

Composition of the Board:

Chairman: G.S.A. Szabo
Members: J.B.F. Kollar
J. van Moer

Summary of Facts and Submissions

- I. European patent application No. 86 901 940.6 (International publication No. WO 86/05520), International filing date 13 March 1986 with GB priority of 14 March 1985, was refused by the Examining Division in a decision taken at the end of the oral proceedings held on 24 November 1989 and issued in written form on 12 February 1990. This decision was based on two different forms of Claim 1 presented during the oral proceedings as main and auxiliary requests.

Claim 1 according to the main request reads as follows:

"1. A method of ironmaking by means of smelting shaft furnace including the steps of supplying iron ore and coke to the top of the furnace; and injecting coal and oxygen into the smelting zone of the furnace, characterised in that the quantities of coal and oxygen injections are selected from within the range of 0.7 to 1.7 of stoichiometric conditions with respect to combustion to carbon monoxide and hydrogen so as to, in combination, promote combustion, to control reaction temperature and provide heat for smelting."

Claim 1 according to the auxiliary request differed from the claim above by restricting the range of 0.7 to 1.7 to 0.7 to 0.99. Dependent Claims 2 to 15 related to further embodiments of features of Claim 1.

- II. The decision explained that the subject-matter of Claim 1 under the main request lacked novelty by implication over the teaching of FR-A-1 259 738 (document D2). Even if this claim were to be considered formally novel, because none of the cited documents expressly disclosed any coal/oxygen range, such a claim

would not involve an inventive step since it had, apparently, no new and inventive effect over that of the process according to document D2.

Regarding Claim 1 according to the auxiliary request, the decision held that said claim did not fulfil all the conditions necessary to acknowledge a selection invention because, at the very least, a specific effect appearing only in the claimed range was lacking so that the requirements for novelty of the claimed selection had not been satisfied. Again, even when such a claim were to be considered as novel the decision came to the conclusion that it would not involve an inventive step for the same reasons as put forward against the main request and because the Applicant could not specify anything which distinguished the restricted range according to the auxiliary request from the originally broader range in an inventive manner.

III. The Appellant (Applicant) lodged an appeal against this decision on 7 April 1990, paying the prescribed fee at the same time, and submitted Grounds of Appeal on 2 June 1990.

The main request presented during the examining procedure has been withdrawn and Claim 1 of the auxiliary request has been prosecuted for reconsideration with a restricted number of dependent Claims 2 to 11. Accordingly, Claim 1 reads as follows:

"1. A method of ironmaking by means of a smelting shaft furnace including the steps of supplying iron ore and coke to the top of the furnace; and injecting coal and oxygen into the smelting zone of the furnace characterised in that the quantities of oxygen and coal injections are selected from within the range of 0.7 to 0.99 of stoichiometric conditions with respect to

combustion to carbon monoxide and hydrogen whereby in combination to promote combustion, to control reaction temperature, and provide heat for smelting."

IV. In response to a communication of the Board, the Appellant filed on 26 July 1993 a technical memorandum stating that the present invention was contrary to the teaching of the prior art and had proved to be of substantial benefit to blast furnace operators.

V. In the written submission and at the oral proceedings held on 29 July 1993 the Appellant argued essentially as follows:

Previous to the present invention when introducing pulverised coal and oxygen-enriched air into blast furnaces, the successful trend consisted in using a sufficient amount of oxygen to burn the coal to the required gaseous product. The conventional ironmaking processes attempted to obtain a gaseous product rich in carbon monoxide in order to effect the direct reduction, but a certain amount of carbon dioxide, hydrogen and/or steam was accepted as a by-product. Documents FR-A-1 010 867 (D1) and D2 were good examples illustrating the afore-mentioned trend of the prior art. As a matter of fact, both documents not only pointed out the importance of presence of oxygen in the introduced mixture to be burned, but also put strong emphasis on the requirement that the amount of oxygen should be sufficient for the mixture to be converted into the gaseous product of the afore-mentioned composition - reference was made in this context especially to page 2, right column, lines 86 to 91 ("...at least as much oxygen as is sufficient") and to page 2, left column, lines 10 to 11 ("...together with sufficient oxygen to burn it to carbon monoxide...") of document D1 and D2 respectively, in their English version GB-A-675 238 and

GB-A-884 493 used hereinafter. The teachings about sufficient amounts of oxygen in the relevant documents D1 and D2 not only followed the established trend of the prior art but must be interpreted as a clear instruction to the skilled person to use quantities of oxygen and coal at the stoichiometric proportion of at least one. Said teachings thus not only confirmed a trend but also formed a prejudice that for achievement of good results it was essential to introduce at least as much oxygen in proportion to coal as corresponded to stoichiometric proportions. The idea is not only based on empirical experience but represents an essential principle for chemical reactions.

Taking into account the above teachings and starting from the younger document D2 representing the closest prior art, the skilled person would have been inhibited from using a quantity of oxygen **less** than stoichiometrically sufficient to convert the mixture oxygen-coal into a product with the required reducing quality.

However, it was demonstrated by the test submitted in the examining procedure, that with the use of the quantities of oxygen and coal injected within the claimed range of 0.7 to 0.99 of stoichiometric conditions, surprising results, evaluated in terms of optimal performance of the furnace concerned and its balance and control, were nevertheless obtained although the skilled person starting from D2 had no incentive to operate in this range for the above reasons. Therefore, there was a surprising effect arising from the claimed range which, for the reasons stated above, then meets the requirements for novelty and involved an inventive step over the cited prior art.

- VI. The Appellant requests that the decision under appeal be set aside and that the patent be granted on the basis of Claims 1 to 11 and description submitted at the oral proceedings and figures as originally filed.

Reasons for the Decision

1. The appeal is admissible.

2. *Allowability of the Amendments*

The features of present Claim 1 are in essence disclosed at page 8, line 20 to page 9, line 6 of the description as originally filed. This passage of the description relates to a typical example of the invention according to which the quantities of coal and oxygen are 0,99 of stoichiometric conditions with respect to combustion to carbon monoxide and hydrogen. Taking into account this example, the new upper limit in Claim 1 is adequately supported by the original disclosure and there are no formal objections under Article 123(2) EPC to this Claim, since the feature itself is not dependent on other features (cf. T 201/83, OJ EPO 1984, page 481).

3. *Novelty*
 - 3.1 Document D2 was regarded as being the closest prior art. This document disclosed the injection of coal with sufficient oxygen into the shaft furnace for forming a gaseous product rich in carbon monoxide and hydrogen. This was considered in the impugned decision to be a clear indication for the skilled person to use a stoichiometric amount of coal and oxygen even if document D2 did not quote a certain ratio. The decision held on page 4, point 4, that, as a consequence thereof,

the originally claimed broad range of 0.7 to 1.7 had been restricted to 0.7 to 0.99 and considered this restriction as a selection invention which, according to the decision, did not satisfy the requirements of novelty in that a specific effect appearing only in the claimed selection was not given. This line of reasoning cannot be accepted by the Board for the following reasons:

3.2 When drafting a patent specification and claims, Applicants, not unreasonably, tend to define the limits of the protection they are seeking as broadly as possible. Thereby, quite often, some parts of a broadly claimed range of values of a certain parameter show in further development of the invention after the application date a less practical relevance than other parts. Applicants are in such circumstances free to restrict the originally claimed range to the narrower one already specifically disclosed and considered of importance for the final protection, especially if the restricted range was originally supported by examples, as in the present case. The Board wishes to point out in this context that a **restriction** of broad ranges, claimed in a patent application as originally filed, into narrower ones, as the case is in the present application, does not necessarily coincide with a **selection** of ranges from the ones known in the state of the art prior to the filing date of the patent application. The test for proper selection invention must be *vis-à-vis* the prior art alone.

3.3 The crucial question in the assessment of the issue of novelty in the present case is whether the restricted range according to valid Claim 1 formed part of the state of the art. This question must be answered in the negative.

3.4 The arguments of the Appellant according to which the skilled person would be inhibited from using a quantity of oxygen less than stoichiometrically sufficient to convert the mixture oxygen-coal into a product having the required reducing properties are convincing, because the consequent teaching of the prior art represented during the procedure of the relevant documents D1 and D2 sets a limit on the proportion of quantities of oxygen and coal at the stoichiometric condition of at least one. It has in this connection been pointed out by the Appellant that in said documents D1 and D2 strong emphasis was repeatedly put on the requirement that the amount of oxygen should be sufficient for the conversion of the mixture into the required reducing gas and that this teaching was a clear instruction to the skilled person to use quantities of oxygen and coal at the stoichiometric ratio of at least one. No range below that value was foreshadowed, recommended or considered, and this was of course in line with the generally known principles in chemistry about bringing a desired reaction to completion.

The conclusion must be that the disclosures illustrated the established trend of the prior art, and formed a prejudice that for the achievement of good results it was essential to operate at a stoichiometric condition of at least one. It follows that the claimed substoichiometric range of 0,7 to 0,99 according to Claim 1 is novel and the subject-matter of this claim thus satisfies the requirements of Article 54 EPC.

4. *Inventive step*

4.1 Starting from D2 as closest state of the art the objective problem to be solved by the invention is to provide a shaft furnace arrangement of improved operation with enhanced consumption of coal and oxygen.

The problem is plausibly solved by the technical means defined by the wording of the characterising portion of Claim 1, i.e. by lowering the stoichiometric proportions below one.

4.2 The main question to be considered in the issue of the assessment of the inventive step in the present case is whether the skilled person, in view of the teaching of the prior art, would find it obvious to try injecting coal and oxygen into a shaft furnace in quantities falling within the scope of Claim 1 in the expectation of enhancement of coal and oxygen consumption and of improvement of operational characteristics of the furnace.

4.3 This question must also be answered in the negative. In view of the established trend in the prior art represented by documents D1 and D2 the skilled person would, as pointed out in section 2.4 above, be prejudiced from injecting the mixture of oxygen and coal in quantities falling within substoichiometric conditions. Thus, the prior art shows that there was a trend in another direction pointing away from the invention. Acting against such a prejudice or trend, as in the present case, may be considered to indicate the existence of inventive step (cf. T 2/81 "Methylenebis (phenyl isocyanate)", OJ EPO 1982, 394 and T 596/90 of 29 January 1993 - unpublished).

4.4 Furthermore, the Board finds it plausible, given the carrying out of chemical reactions by burning carbonaceous fuel into stack gases requires a sufficient amount of oxygen - irrespective of the proportion of carbon monoxide and carbon dioxide in the obtained gases - that the skilled operator of shaft furnaces would also have been deterred from reducing the proportional quantity of oxygen in the injected mixture

of oxygen and fuel into the range comprehended by the terms of Claim 1 of the present application, because it was well known that the thermal conditions of shaft furnaces were very sensitive to reduction of oxygen affecting the endothermic reactions in the furnace. It was, therefore, surprising that the restriction of the amount of oxygen in the injected oxygen-coal-mixture to a ratio within the claimed range of 0.7 to 0.99 resulted in advantageous operational conditions of the furnace; it was particularly surprising that the operation already at the upper end border of the claimed range, i.e. at 0.99, provided for such unexpected effect in terms of a substantially reduced consumption of coke per unit of iron, as shown by examples presented in the specification as filed and as supported by the test results submitted in the examining procedure.

Actually, (D1) also explained that some carbon dioxide is also formed in the preferred method according to the state of the art (cf. page 2, lines 89 to 98). It adds that certain amounts of this may not only be allowed but could be useful since this reacts with "lumpy fuel". Thus the need for such conditions would rather imply at least initially a bit of excess oxygen rather than the contrary.

4.5 The subject-matter of Claim 1 thus involves an inventive step as required by Article 56 EPC. Since Claims 2 to 11 are dependent on Claim 1, they too are directed to subject-matter which is novel and inventive, and therefore patentable.

Order

For these reasons, it is decided that:

1. The decision under appeal is set aside.
2. The application is remitted to the first instance with the order to grant a patent on the basis of the documents submitted at the oral hearing, figures as originally filed.

The Registrar:



S. Fabiani

The Chairman:


G. Szabo

DM.

