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D E C I S I O N
of 22 July 2004

Case Number: T 0548/02 - 3.2.2

Application Number: 97950427.1

Publication Number: 0953058

IPC: C21B 13/00

Language of the proceedings: EN

Title of invention:
Production method of metallic iron

Applicant:
KABUSHIKI KAISHA KOBE SEIKO SHO

Opponent:
-

Headword:
-

Relevant legal provisions:
EPC Art. 56

Keyword:
"Inventive step (yes) after amendment"

Decisions cited:
-

Catchword:
-

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Case Number: T 0548/02 - 3.2.2

D E C I S I O N
of the Technical Board of Appeal 3.2.2
of 22 July 2004

Appellant: KABUSHIKI KAISHA KOBE SEIKO SHO
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Decision under appeal: **Decision of the Examining Division of the European Patent Office posted 26 November 2001 refusing European application No. 97950427.1 pursuant to Article 97(1) EPC.**

Composition of the Board:

Chairman: T. Kriner
Members: R. Ries
A. Pignatelli

Summary of Facts and Submissions

I. The appellant (applicant) lodged an appeal, received at the EPO on 24 January 2002, against the decision of the examining division posted on 26 November 2001 concerning the refusal of the European patent application No. 97950427.1. The fee for appeal was paid simultaneously and the statement setting out the grounds of appeal was received on 22 March 2002.

II. The examining division held that the application did not meet the requirements of Article 56 EPC, having regard to document

D1: DE-A-2 514 325

which discloses the heating and melting of integral agglomerates (pellets) after pre-reducing the agglomerates in a shaft furnace. According to the examining division, it is not apparent from the application that the restriction of the claimed method to the supply of "un-reacted pellets" (ie. without drying and preliminary reducing the pellets) actually solves a specific technical problem, the more so since the supply of compacts comprising pre-reduced iron ore is mentioned as being preferred. The claimed method was, therefore, held to lack an inventive step with respect to the technical teaching set out in the prior art D1.

III. In the annex to the summons to attend oral proceedings, the appellant was, in addition to document D1, further referred to document

D2: US-A-5 411 570 & JP-A-7054030

which is acknowledged as technical background in the present application. The Board expressed it's provisional view that the claimed subject matter set out in the main request and the auxiliary request would not comprise patentable matter with respect to document D2.

IV. Oral proceedings took place on 22 July 2004. The appellant requested that the decision under appeal be set aside and a patent be granted on the basis of the following documents all submitted at the oral proceedings:

claims: 1 to 11

description: pages 1 to 19

figures: 1/8 to 8/8

V. Independent claim 1 reads as follows:

"1. A method of producing a metallic iron by reducing a compact containing a carbonaceous reductant and an iron oxide by heat, comprising the steps of:
supplying the compact to a molten iron bath or a molten slag on the molten iron bath, in a furnace having a high temperature atmosphere, so that the compact comes in direct contact with the molten iron bath or the molten slag; and
causing the supplied compact to float on the molten iron bath and/or the molten slag such that at least a part of the compact surface is substantially exposed to the high temperature gas atmosphere in the furnace,

until the iron oxide in the compact is substantially reduced,
wherein the thickness of the molten slag is adjusted to be equivalent to or within twice or three times as large as the particle size of the compact,
including the step of causing a flow of the molten iron at least on a surface portion of the molten iron bath, wherein the compact is supplied at an upstream side of the flow and is reduced while moving along the flow direction of the molten iron."

VI. The appellant argued as follows:

The application aims at providing a process which enables with a simple operation the efficient reducing and melting of a compact, in particular pellets. This object is achieved by reducing in the furnace the compacts (A) while floating on a "thin" slag layer covering the molten iron bath. Specifically, the thickness of the molten slag layer is controlled to be equivalent to or within twice or three times as large as the size of the compact (A). In so doing, the heat is transmitted with a very high efficiency to the compact(s) by the molten iron bath, the radiation of the hot furnace atmosphere and by the burners. Neither of documents D1 or D2 which are both referred to on pages 3 and 4 of the present application do disclose or suggest that the heat efficiency of the process could be significantly improved by floating the compact(s) on the "thin" layer of the slag stipulated in claim 1 of the application. Hence, the claimed process is novel and involves an inventive step with respect to documents D1 and D2.

Reasons for the Decision

1. The appeal is admissible.

2. *Amendments*

Claim 1 results from the wording of originally filed claims 1, 2 and 10 in combination with the technical information given on page 14, lines 7 and 8 of the description. Dependent claims 2 to 11 correspond to claims 3 to 9, 11, 13 and 14 as originally filed, respectively.

The description has been suitably adapted to the revised claims and includes further editorial amendments. Figures 1 to 8 correspond to the Figures of sheets 1/8 to 8/8 as originally filed.

Hence, there are no formal objections to the amended documents with respect to Article 123(2) EPC.

3. *The closest prior art*

Like the present application, document D2 is concerned with a method of making steel in a high temperature furnace including the steps of heating a burden containing iron and carbon and maintaining the temperature of the liquid product so formed above its liquidus temperature by controlling the amount of heat supplied to the furnace and/or the rate at which the burden is added to the furnace (cf. D2, claim 1; column 1, lines 52 to 59). The burden comprising sponge iron, partially reduced iron ore or "self-reducing

pellets" (compacts) consisting of fine iron ore and fine coal is added to a molten metal bath covered with a slag layer and comprised in a high temperature furnace which is heated by induction heaters 17 located below the furnace and by oxygen-fuel burners 16 inside the furnace (cf. D2, column 1, lines 52 to 64, column 2, lines 1 and 2; lines 40 to 63, column 4, lines 31 to 52; example 4; Figures 1 to 4; claims 1, 3, 9, 10, 12). In order to increase the reduction rate, the pellets can be added together with carbon (cf. D2, column 4, lines 49 to 53) and the slag composition (basicity, melting point, viscosity etc) is controlled by appropriate additions a fluxing agent for the effective removal of silicon, phosphorus and Fe0 thus protecting the refractory lining of the furnace from the aggressive attack of the FeO dissolved in the molten slag (cf. D2, column 1, lines 35 to 43; column 2, lines 60 to 63; column 3, lines 47 to 58; claims 19, 20). Given that the hot metal is tapped via outlet 14 and the liquid slag via tap hole 15, a flow at least on the surface portion of the molten iron bath is generated (cf. D2, Figure 3; column 4, lines 62 to 67).

A similar process is disclosed in document D1. In a first step, the agglomerates (in particular pellets comprising a mixture of iron ore fines, a carbonaceous material and a binder) are heated and reduced in a shaft-type furnace and are then transferred at an elevated temperature of about 1050°C to 1300°C to a melting vessel for melting the agglomerates with release of molten metal to form a combination of molten metal and slag which are then discharged (cf. D1, page 3, second full paragraph; page 4, last paragraph to page 5, end of the first paragraph). As depicted in

Figure 1, the melting vessel, however, comprises a refractory dam 11 which prevents the pellets from floating with the slag to flush hole 16 (cf. D1 page 7, second paragraph, lines 17 to 21).

4. *Novelty*

None of the document D1 or D2 discloses the height of the slag layer covering the molten iron bath in the melting furnace or gives any information that a particular thickness of that slag layer needs to be adhered to. The subject matter of claim 1 is, therefore, novel.

5. *Technical problem and solution; inventive step*

5.1 Based on the above considerations, the process disclosed in document D2 represents the most suitable starting point. The technical problem to be solved in view of this prior art, as it is correctly indicated on page 7, last paragraph, of the application, therefore, resides in improving significantly the heat efficiency of the process for melting and reducing various kinds of agglomerates or compacts comprising iron ore and a carbonaceous reductant.

The Board has no reason to doubt that this technical problem has been actually solved by the step of floating the compacts on an iron bath covered with a "thin" molten slag layer of the thickness stipulated in claim 1, such that a substantial part of compact remains exposed to the high temperature gas atmosphere of the furnace while the other part of the compact is embedded in the molten slag. In doing so, the heat

transferred by the molten iron bath and by the furnace atmosphere to melt and reduce the compact is markedly improved. If, as set out in the application on page 13, last paragraph, a "thick" layer of molten slag is selected instead, the compact (A) sinks into and is enveloped by the molten slag so that the heat transfer from the molten iron bath below and by the radiation from the hot furnace atmospheres is inhibited and, in consequence thereof, the heat efficiency of the process is drastically reduced. Consequently, the thickness of the slag layer needs to be adjusted so that it is equivalent to or twice or three times the size of the compact (A), i.e. the particle size of the pellets (cf. the application page 13, second full paragraph to page 14, end of the first full paragraph).

Although document D2 mentions in column 4, lines 62 to 67 that the molten slag actually flows in a trough-like corridor which extends between the two sections of burden 19 (i.e. the agglomerates) from inlet 13 towards outlet 15, there is no suggestion in this document of any advantage to be gained for improving the heat efficiency of the process from the strict limitation of the thickness of the slag covering the iron melt. Hence, document D2 does not contain any information from which the skilled person could infer the advantage gained in the claimed process.

Nor does document D1 contain any information which might be relevant to this issue.

5.2 Consequently, the subject matter of claim 1 is non-obvious over the technical teaching given in document D2 or D1 alone or over the combined teaching given in

these documents and, therefore, involves an inventive step within the meaning of Article 56 EPC.

5.3 The dependent claims 2 to 11 relate to preferred embodiments of the process set out in claim 1 and are, therefore, likewise allowable.

Order

For these reasons it is decided that:

1. The decision under appeal is set aside.

2. The case is remitted to the first instance with the order to grant a patent on the basis of the following documents:

Claims: 1 to 11 as filed during the oral proceedings,

description: pages 1 to 19 as filed during the oral proceedings,

drawings: Figures 1 to 8 as filed during the oral proceedings.

The Registrar: The Chairman:

G. Magouliotis T. Kriner