METHOD AND APPARATUS FOR PREHEATING OF DIRECT REDUCED IRON USED AS FEED TO AN ELECTRIC ARC FURNACE

Abstract: A method and apparatus for preheating of direct reduced iron or DRI (10) prior to its introduction to a metallurgical furnace like an electric arc furnace (70) by contacting the DRI (10) with a non-oxidizing, reducing or carburing gas (44) at a high temperature so that electric demand in the furnace (70) can be reduced, the tap-to-tape time can be decreased, whereby the productivity of the furnace (70) as well as the carbon content of the DRI to be charged can be increased.
(88) Date of publication of the international search report: 26 July 2001

For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.
INTERNATIONAL SEARCH REPORT

A. CLASSIFICATION OF SUBJECT MATTER
IPC(7) :F27D 13/00; H05B 7/18; C21C 7/00
US CL :373/80; 75/46
According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED
Minimum documentation searched (classification system followed by classification symbols)
U.S. : 373/1, 2, 8-9, 42-43, 60, 66, 71, 77-81; 75/10.50, 10.63, 10.66, 35, 45-46, 490, 494-495; 266/44, 142, 144, 156

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)
EAST, WEST
    search terms: direct reduce iron or DRI, preheating, non adj oxidizing adj gas, nonoxidizing gas, CO or carbon monoxide, hydrogen, reducing adj gas, 373/5.ccls., 75/5.ccls.

C. DOCUMENTS CONSIDERED TO BE RELEVANT

<table>
<thead>
<tr>
<th>Category*</th>
<th>Citation of document, with indication, where appropriate, of the relevant passages</th>
<th>Relevant to claim No.</th>
</tr>
</thead>
<tbody>
<tr>
<td>X</td>
<td>US 4,609,400 A (VALLOMY) 02 SEPTEMBER 1986, Col. 3, line 58 to col.4, line 24, col. 5, lines 8-14, and Figures 1-2.</td>
<td>1, 3,12, and 14.</td>
</tr>
<tr>
<td>A</td>
<td>US 5,400,358 A (VALLOMY) 21 MARCH 1995, see the entire reference.</td>
<td>1-3 and 12-14.</td>
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<tr>
<td>X</td>
<td>US 5,529,599 A (CALDERON) 25 JUNE 1996, abstract, col.2, lines 11-25, and Figure 2.</td>
<td>1-3 and 12-14.</td>
</tr>
</tbody>
</table>

[X] Further documents are listed in the continuation of Box C. [ ] See patent family annex.

Date of the actual completion of the international search 21 DECEMBER 2000

date of mailing of the international search report 06 FEB 2001

Name and mailing address of the ISA/US Commission for Patents and Trademarks
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Form PCT/ISA/210 (second sheet) (July 1998)
<table>
<thead>
<tr>
<th>Category</th>
<th>Citation of document, with indication, where appropriate, of the relevant passages</th>
<th>Relevant to claim No.</th>
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<tbody>
<tr>
<td>A</td>
<td>US 5,588,982 A (HENDRIX) 31 DECEMBER 1996, see the entire reference.</td>
<td>1-3 and 12-14.</td>
</tr>
<tr>
<td>A</td>
<td>US 5,603,748 A (HIRSCH et al) 18 FEBRUARY 1997), see the entire reference.</td>
<td>1-3 and 12-14.</td>
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<tr>
<td>A</td>
<td>US 4,931,090 A (BOTTINELLI et al) 05 JUNE 1990, see the entire reference.</td>
<td>1-3 and 12-14.</td>
</tr>
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</table>
### Box I  Observations where certain claims were found unsearchable (Continuation of item 1 of first sheet)

This international report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:

1. ☐ Claims Nos.:
   because they relate to subject matter not required to be searched by this Authority, namely:

2. ☐ Claims Nos.:
   because they relate to parts of the international application that do not comply with the prescribed requirements to such an extent that no meaningful international search can be carried out, specifically:

3. ☒ Claims Nos.: 4-11 AND 15-17
   because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a).

### Box II  Observations where unity of invention is lacking (Continuation of item 2 of first sheet)

This International Searching Authority found multiple inventions in this international application, as follows:

1. ☐ As all required additional search fees were timely paid by the applicant, this international search report covers all searchable claims.

2. ☐ As all searchable claims could be searched without effort justifying an additional fee, this Authority did not invite payment of any additional fee.

3. ☐ As only some of the required additional search fees were timely paid by the applicant, this international search report covers only those claims for which fees were paid, specifically claims Nos.:

4. ☐ No required additional search fees were timely paid by the applicant. Consequently, this international search report is restricted to the invention first mentioned in the claims; it is covered by claims Nos.:

Remark on Protest ☐ The additional search fees were accompanied by the applicant’s protest.
☐ No protest accompanied the payment of additional search fees.

Form PCT/ISA/210 (continuation of first sheet(1)) (July 1998)