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**Declarations under Rule 4.17:**

- as to applicant's entitlement to apply for and be granted a patent (Rule 4.17(ii))
- as to the applicant's entitlement to claim the priority of the earlier application (Rule 4.17(iii))
- of inventorship (Rule 4.17(iv))

[Continued on next page]

(54) **Title:** METHOD FOR PRODUCING DIRECT REDUCED IRON WITH LIMITED CO2 EMISSIONS

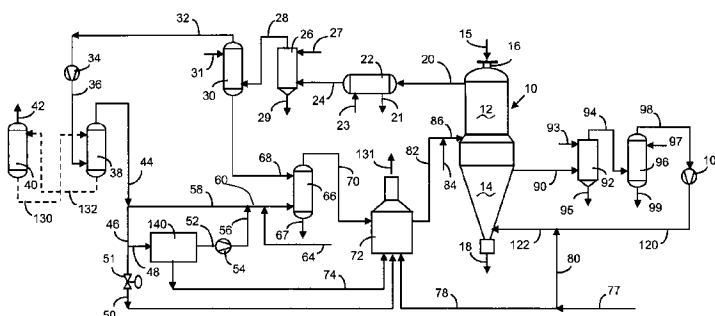


Figure 2

(57) **Abstract:** A method and apparatus for producing direct reduced iron (DRI), also known as sponge iron, by means of direct contact of iron oxides with a stream of recycled and regenerated hot reducing gases containing hydrogen and carbon monoxide. The invention provides a way for decreasing the uncontained emission of CO<sub>2</sub> to the atmosphere produced by combustion of carbon-bearing fuels in the reducing gas heater by substituting, at least partially, a gas stream mainly composed of hydrogen in lieu of the usual carbon-bearing fuels. The hydrogen fuel stream, depleted of CO<sub>2</sub> by means of a physical gas separation unit (which can be a PSA/VPSA type adsorption unit, a gas separation membrane unit or combination of PSA/VPSA unit and a gas separation membrane unit) is derived from at least a portion of a stream of regenerated reducing gases being recycled to the reduction reactor. The derived hydrogen fuel stream is combusted in the reducing gas heater and/or other thermal equipment in the reduction plant, thus decreasing the CO<sub>2</sub> emissions directly to the atmosphere.



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<b>A. CLASSIFICATION OF SUBJECT MATTER</b> INV. C21B13/02      B01D53/04      B01D53/14      C10K1/00 ADD.				
According to International Patent Classification (IPC) or to both national classification and IPC				
<b>B. FIELDS SEARCHED</b>				
Minimum documentation searched (classification system followed by classification symbols) C21B B01D C10K				
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 practical, search terms used) EPO-Internal, WPI Data				
<b>C. DOCUMENTS CONSIDERED TO BE RELEVANT</b>				
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.		
A	US 2003/047037 A1 (SETHNA RUSTAM H [US] ET AL) 13 March 2003 (2003-03-13) cited in the application the whole document -----	1-15		
A	US 5 110 350 A (VILLARREAL-TREVINO JUAN A [MX] ET AL) 5 May 1992 (1992-05-05) cited in the application the whole document -----	1-15		
A	WO 97/07247 A1 (VOEST ALPINE IND ANLAGEN [AT]; DIEHL JOERG [AT]; ROSENFELLNER GERALD []) 27 February 1997 (1997-02-27) the whole document -----	1-15		
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<input checked="" type="checkbox"/> Further documents are listed in the continuation of Box C. <input checked="" type="checkbox"/> See patent family annex.				
* Special categories of cited documents : <table style="width: 100%; border: none;"> <tr> <td style="width: 50%; border: none; vertical-align: top;">                     "A" document defining the general state of the art which is not considered to be of particular relevance                      "E" earlier document but published on or after the international filing date                      "L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)                      "O" document referring to an oral disclosure, use, exhibition or other means                      "P" document published prior to the international filing date but later than the priority date claimed                 </td> <td style="width: 50%; border: none; vertical-align: top;">                     "T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention                      "X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone                      "Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.                      "&amp;" document member of the same patent family                 </td> </tr> </table>			"A" document defining the general state of the art which is not considered to be of particular relevance "E" earlier document but published on or after the international filing date "L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified) "O" document referring to an oral disclosure, use, exhibition or other means "P" document published prior to the international filing date but later than the priority date claimed	"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention "X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone "Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art. "&" document member of the same patent family
"A" document defining the general state of the art which is not considered to be of particular relevance "E" earlier document but published on or after the international filing date "L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified) "O" document referring to an oral disclosure, use, exhibition or other means "P" document published prior to the international filing date but later than the priority date claimed	"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention "X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone "Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art. "&" document member of the same patent family			
Date of the actual completion of the international search	Date of mailing of the international search report			
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Name and mailing address of the ISA/ European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Fax: (+31-70) 340-3016	Authorized officer  Ceulemans, Judy			

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C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

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