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**Datasheet for the decision
of 16 April 2024**

Case Number: T 0831/22 - 3.3.05

Application Number: 13843707.4

Publication Number: 2904122

IPC: C21B13/02, F27B1/00, F27B1/10,
F27D99/00

Language of the proceedings: EN

Title of invention:

METHODS FOR ENHANCING BURDEN UNIFORMITY IN A COMBINATION
REFORMING/REDUCING SHAFT FURNACE

Patent Proprietor:

Midrex Technologies, Inc.

Opponent:

Danieli & C. Officine Meccaniche S.p.A. /
Tenova S.p.A.

Headword:

Shaft furnace/MIDREX

Relevant legal provisions:

EPC Art. 56, 123(2), 123(3)
RPBA 2020 Art. 13(2)

Keyword:

Amendments - extension beyond the content of the application
as filed (no) - broadening of claim (no)
Amendment after summons - exceptional circumstances (no) -
taken into account (no)
Inventive step - main request (yes) - non-obvious modification

Decisions cited:

T 0574/17

Catchword:



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Case Number: T 0831/22 - 3.3.05

D E C I S I O N
of Technical Board of Appeal 3.3.05
of 16 April 2024

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Decision under appeal: **Interlocutory decision of the Opposition
Division of the European Patent Office posted on
27 January 2022 concerning maintenance of the
European Patent No. 2904122 in amended form.**

Composition of the Board:

Chair G. Glod
Members: T. Burkhardt
R. Winkelhofer

Summary of Facts and Submissions

I. The opponents' (appellants') joint appeal is against the opposition division's decision to maintain European patent No. 2 904 122 B1 as amended on the basis of the first auxiliary request then on file.

II. The following documents discussed at the opposition stage are relevant to the present decision:

- D1 US 4,118,017 A
- D3 WO 01/18257 A1
- D4 WO 00/36157 A1
- D5 B. Franco et al., "ENERGIRON - THE MOST MODERN AND COST EFFECTIVE DRI TECHNOLOGIES", 8th Ironmaking Conference, IAS, 2011, Rosario, Santa Fe, Argentina
- D6 A. Volpatti et al., "Energiron Direct Reduction Process: The Forefront Technology", 2012 AISTech Conference Proceedings
- D7 Steel Times International 34(3), April 2010

III. Independent claim 1 of the main request reads as follows (with the feature numbering of the impugned decision (point 3.1)).

- a) "A method for operating a combination high pressure reforming and reducing shaft furnace for the production of direct reduced iron,
- b) wherein one or more burden uniformity enhancing devices are disposed within an interior portion of the shaft furnace,
- c) wherein the one or more burden uniformity enhancing devices comprise one or more

- rotating or reciprocating mixing shafts, or one or more agitators,
- d) wherein the one or more burden uniformity enhancing devices are disposed within both a reforming zone and a reducing zone within the interior portion of the shaft furnace,
 - e) wherein the shaft furnace includes a plurality of pellet or agglomerate inlet pipes and one or more bustle gas inlet pipes, the method comprising:
 - f) maintaining a pressure of greater than 5 atmospheres;
 - g) selectively introducing iron ore pellets or agglomerates forming a burden in the shaft furnace;
 - h) selectively introducing a bustle gas to be reformed and directly reduce the iron ore pellets and
 - i) operating the one or more burden uniformity enhancing devices for churning the burden disposed within the interior portion of the shaft furnace and
 - j) exposed to the pressure of greater than 5 atmospheres such that both reforming and reducing take place uniformly throughout the burden disposed within the interior portion of the shaft furnace."

Dependent claims 2 to 5 relate to further embodiments.

IV. The arguments made by the appellants during the appeal proceedings, where relevant to the present decision, can be summarised as follows:

The main request did not meet the requirements of Article 123(2) and (3) EPC.

Moreover, the main request did not meet the requirements of Article 56 EPC in view of:

- D4 as the closest prior art in combination with D5, D6 or D7, or the statements made in the patent in suit itself
- D1 or D3 as the closest prior art in combination with D5, D6 or D7

The new line of attack concerning the lack of inventive step in view of D3, which had been presented at the oral proceedings at the appeal stage, should be considered since it was *prima facie* relevant.

- V. The arguments made by the patent proprietor (respondent) during the appeal proceedings, where relevant to the present decision, can be summarised as follows:

The main request met the requirements of the EPC.

The appellants' new line of attack concerning a lack of inventive step in view of D3 should not be considered.

- VI. The appellants requested that the decision under appeal be set aside and amended such that the patent be revoked.

The respondent requested that the appeal be dismissed (main request). Alternatively, they requested that the patent be maintained in amended form on the basis of:

- one of auxiliary requests 1a, 1b and 2 to 7, which were submitted on 30 March 2023, or

- one of auxiliary requests 8 to 14, which were submitted on 13 March 2024.

Reasons for the Decision

Main request

The main request is identical to auxiliary request 1 as upheld by the opposition division.

In line with the opposition division's conclusion, the main request is allowable for the reasons set out below:

1. Article 123(2) EPC
- 1.1 Feature (f) of claim 1

In the appellants' view, the word "maintaining" in "maintaining a pressure of greater than 506.625 kPa (= 5 atmospheres)" in claim 1 went beyond the disclosure of the application as originally filed. In their opinion, a pressure drop inevitably occurred along the shaft furnace. Moreover, "maintaining" involved a kind of adjustment not disclosed in the application as originally filed.

This is not convincing. The end of paragraph [0006] of the application as originally filed discloses an application "in high pressure (i.e. greater than 5 atm) direct reduction processes". The skilled person understands that in this kind of process the pressure is maintained in the specified pressure range. The pending claim 1 does not exclude different portions of

the shaft furnace being operated at different pressures, provided that the pressure everywhere is above 5 atm.

1.2 Features (i) and (j) of claim 1

1.2.1 The appellants argued in their grounds of appeal that feature (i) and the *first part* of feature (j) of claim 1, i.e. "for churning the burden disposed within the *interior portion* of the shaft furnace and exposed to the pressure of greater than 506.625 kPa" (emphasis added by the board), found no support in the application as originally filed, which, in their view, only supported the "burden in the shaft furnace".

However, the fact that the "burden uniformity enhancing devices", which cause the churning, are located in the interior portion of the shaft furnace is mentioned in the second paragraph of claim 7 as originally filed, which is the basis for claim 1. A churning of the burden by the uniformity enhancing devices in the interior portion of the shaft furnace is also disclosed in paragraph [0007] of the application as originally filed.

1.2.2 At a later stage, the appellants also made reference to the *second part* of feature (j) of claim 1, which requires "that both reforming and reducing take place uniformly throughout the burden disposed within the interior portion of the shaft furnace". In their view, claim 1 now also covered an embodiment where reforming/reducing reactions in a *remaining portion* of the shaft furnace, where no uniformity enhancing devices were present and where the burden was hence not churned (in contrast to the "interior portion", within which such uniformity enhancing devices were disposed), took place

in a non-uniform manner. Such an embodiment was not disclosed in the application as originally filed.

The question of whether this allegation of fact is to be considered under Article 13(1) RPBA 2020 does not need to be answered. The allegation is not convincing anyway. In fact, there is no reason to conclude that claim 7 as originally filed does not also cover an embodiment where reforming/reducing reactions take place in a non-uniform manner in such a *remaining portion* of the shaft furnace.

2. Article 123(3) EPC

In the appellants' view, the replacement of the feature "maintaining an interior portion of the shaft furnace at a pressure of greater than 506.625 kPa (= 5 atmospheres)" in claim 1 as granted (emphasis added by the board) by "maintaining a pressure of greater than 506.625 kPa (= 5 atmospheres)" in claim 1 of the main request extended the protection conferred, since it covered a further embodiment.

This objection is not convincing either. A situation where in the *entire* process a pressure of greater than 5 atm is maintained does not result in a broadening of the scope of protection when compared with a situation where at least an interior portion of the shaft furnace is operated at this pressure.

Consequently, the main request also meets the requirements of Article 123(3) EPC.

3. Article 56 EPC

In the written proceedings, the appellants objected to the inventive character of the subject-matter of claim 1 in view of:

- D4 in combination with each of D5, D6, D7 and the statements made in the patent itself
- D1 or D3 in combination with D5, D6 or D7

This is not convincing either.

3.1 The invention relates to a method for operating a reforming and reducing shaft furnace.

3.2 Closest prior art

For the reasons set out below, D4 - and not D1 or D3 - is the closest prior art.

3.2.1 **D4** deals with the direct reduction of iron oxides in a shaft furnace that includes *in-situ* reforming by injecting hydrocarbons together with the reducing gas (Figure 1, claim 15).

Tuyères 22a, 22b and 22c (embodiment of Figure 7 and second full paragraph on page 12) and tubes 28 equipped with rotary movement (embodiment of Figure 8 and fifth paragraph on page 13) are intended to introduce gas in a uniform manner.

With regard to the iron ore, Figure 1 also provides a distribution system 17 above the reduction zone 110 to load the material uniformly into the furnace (paragraph bridging pages 8 and 9).

Hence, D4 also aims at a proper distribution and uniformity of the gas and of the burden.

Since D4 relates to the same technical field, has the same purpose and numerous features in common with the subject-matter of claim 1 of the patent in suit, it is a suitable starting point for assessing inventive step.

3.2.2 In contrast, the appellants acknowledged, at least at the beginning of the appeal proceedings, that **D1** and **D3** did not explicitly disclose *in-situ* reforming, i.e. reforming in the shaft furnace, and that D1 and D3 "appear[ed] to be further away than D4".

3.2.3 Only at the oral proceedings at the appeal stage did the appellants change their line of attack with regard to **D3**. For the first time, they referred to the passage on page 5, lines 13 to 16, which explained that the reducing gas could be of the type described in document WO 00/36156 A (which is not part of the proceedings).

The appellants further argued that claims 1 and 2 of WO 00/36156 A disclosed the injection of hydrocarbons, which implied *in-situ* reforming.

Moreover, the appellants pointed for the first time to various passages on pages 3 to 7 and to Figure 1 of D3, which allegedly disclosed the remaining features of claim 1 of the main request, apart from high-pressure operation.

In the appellants' view, this line of attack should be admitted in spite of its late submission, because of its *prima-facie* relevance.

However, this is not the relevant question under Article 13(2) RPBA 2020. It has not been disputed that neither WO 00/36156 A nor the cited passages of D3 had been mentioned earlier in the appeal proceedings. These submissions are therefore an amendment to the appellants' case.

Under Article 13(2) RPBA 2020, any amendment to a party's appeal case made after notification of a communication under Article 15(1) RPBA 2020 is, in principle, not to be taken into account unless there are exceptional circumstances which have been justified with cogent reasons by the party concerned.

Prima facie relevance cannot *per se* constitute exceptional circumstances at this stage of the proceedings (Case Law of the Boards of Appeal, 10th edn., V.A.4.5.8 i)).

Under the circumstances of the case at hand with no new considerations in the communication pursuant to Article 15(1) RPBA, there is no need to assess the *prima facie* relevance of the objection to conclude that there are no exceptional circumstances under Article 13(2) RPBA 2020 (see, for example, T 574/17, Reasons 2.3.3).

Consequently, this new line of attack based on D3 as the closest prior art cannot be admitted into the proceedings (Article 13(2) RPBA 2020).

- 3.3 According to the patent in suit, the problem to be solved is the provision of a more efficient method (paragraph [0007]).

- 3.4 The patent proposes solving this problem by the method of claim 1, characterised in that
- (i) a pressure of greater than 5 atmospheres is maintained
 - (ii) devices are present that enhance the uniformity of the burden ("burden uniformity enhancing devices") in the reforming and reducing zones in the form of one or more rotating or reciprocating mixing shafts, or one or more agitators operated for churning the burden

The appellants only acknowledged feature (i) as a distinguishing feature over D4. By contrast, they argued that tuyères 22 (embodiment of Figure 7) and tubes 28 equipped with peripheral apertures and a rotary movement (embodiment of Figure 8) anticipated feature (ii).

With regard to feature (ii), it is firstly noted that tuyères 22a, 22b and 22c and tubes 28 refer to different embodiments ("variants", see page 12, line 7, and page 13, line 8).

All these devices introduce gas (page 12, lines 8, 18 and 19; page 13, lines 21 and 22). D4 does not mention any rotary movement of the tuyères 22 of the embodiment of Figure 7, contrary to claim 1 of the patent in suit.

Furthermore, D4 does not explicitly disclose that the tuyères 22 or tubes 28 churn the burden, nor is this implicit as alleged by the appellants. In fact, D4 is silent on any protruding structure on the tuyères 22 or tubes 28 that could cause a churning of the burden. Contrary to the appellants' view, a churning of the burden is also not implied by the resulting uniform direct reduction reactions mentioned on page 12, lines 31 to 33, of D4.

Feature (ii) is thus a second distinguishing feature. Even if the patent in suit indicates that the injection of gas can modify particle flow (paragraph [0021]), this is not necessarily the case for the gas injection in D4.

- 3.5 It has not been contested that the higher pressure results in increased reforming and reduction reaction rates. Moreover, it is likely that an improved distribution of the burden in the reforming and reducing zones further increases process efficiency.

There is even an effect related to the combination of the distinguishing features, since an improved distribution is even more necessary and effective when the reactions rates are higher due to the elevated pressure.

Thus, the problem has been solved with success.

- 3.6 There is no suggestion in D4 to churn the burden in the reforming and the reducing zones for solving the technical problem.

On the contrary, since D4 *already* foresees distribution system 17 above reduction zone 110, the skilled person has no incentive to provide devices that churn the burden in the reforming and reducing zones, even if devices to minimise burden clumping as such were already known (paragraph [0008] of the patent in suit).

The questions of whether the priority of the patent in suit is valid and whether documents **D5**, **D6** and **D7** are prior art under Article 54(2) EPC notwithstanding, no

such incentive can be found in any of these documents either. This has not been disputed.

Consequently, the subject-matter of claim 1 involves an inventive step within the meaning of Article 56 EPC.

3.7 The same reasoning applies to the subject-matter of the dependent claims (Article 56 EPC).

Order

For these reasons it is decided that:

The appeal is dismissed.

The Registrar:

The Chair:



C. Vodz

G. Glod

Decision electronically authenticated