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Datasheet for the decision of 25 May 2023

Case Number: T 1746/21 - 3.3.05

Application Number: 12860851.0

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IPC: C21B5/00, C21B7/00, C21B7/16

Language of the proceedings: EN

Title of invention:
BLAST FURNACE OPERATION METHOD

Patent Proprietor:
JFE Steel Corporation

Opponent:
Paul Wurth S.A.

Headword:
Blast Furnace Operation/JFE

Relevant legal provisions:
EPC Art. 56
RPBA 2020 Art. 12(6), 13(2)

Keyword:
Inventive step - main request (no) - obvious combination of known features - auxiliary request (yes) - teaching away (yes)
Late-filed objection - admitted (no) - should have been submitted in first-instance proceedings (yes)

Decisions cited:

Catchword:

Europäisches Patentamt
European Patent Office
Office européen des brevets

Beschwerdekammern

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Case Number: T 1746/21 - 3.3.05

D E C I S I O N
of Technical Board of Appeal 3.3.05
of 25 May 2023

Appellant 2: (Patent Proprietor)	JFE Steel Corporation 2-3, Uchisaiwaicho 2-chome Chiyoda-ku Tokyo 100-0011 (JP)
Representative:	Hoffmann Eitle Patent- und Rechtsanwälte PartmbB Arabellastraße 30 81925 München (DE)
Appellant 1: (Opponent)	Paul Wurth S.A. 32, rue d'Alsace 1122 Luxembourg (LU)
Representative:	Office Freylinger P.O. Box 48 8001 Strassen (LU)
Decision under appeal:	**Interlocutory decision of the Opposition Division of the European Patent Office posted on 28 July 2021 concerning maintenance of the European Patent No. 2796566 in amended form.**

Composition of the Board:

Chairman	E. Bendl
Members:	T. Burkhardt
	S. Fernández de Córdoba

Summary of Facts and Submissions

I. The appeals lodged by the patent proprietor (appellant 2) and opponent (appellant 1) are against the opposition division's decision to maintain European patent No. 2 796 566 B as amended on the basis of what was then auxiliary request 4.

II. The following documents were among those discussed at the opposition stage:

D1 JP 2000-192119 A
D1T English translation of D1
D3 WO 2008/006764 A1
D5 V. A. Nozdrachev *et al.*, "Development of the Technology of Injecting Pulverized-Coal Fuel into the Blast Furnace (Analysis of World Practice for the Period 1993-1997)", Metallurgist, Vol. 42, No. 8, 1998, 302f
D7 JP 2003-286511 A

III. After a first translation submitted at the opposition stage, the opponent submitted a second translation of D7 with its statement setting out the grounds of appeal:

D7T2 second English translation of D7

IV. The opposition division held, *inter alia*, that the patent as granted and auxiliary request 3 lacked inventive step in view of D7 in combination with D3.

V. In the appeal proceedings, the patent proprietor maintained the main request (claims as granted) and, *inter alia*, auxiliary requests 3 to 8. The main request and auxiliary request 3 were dealt with in the decision under appeal.

VI. Independent claim 1 of auxiliary request 3 reads as follows (additions with respect to claim 1 of the main request have been underlined):

"1. A blast furnace (1) operation method, comprising:
preparing pulverized coal (6) having a volatile matter content of 25 mass% or less;
preparing a double wall lance (4) for injecting the pulverized coal and a combustion-supporting gas (9) through a tuyere (3), the double wall lance having an inner tube (21) and an outer tube (22);
blowing hot air through the tuyere;
circumferentially forming a plurality of notches (23) in a [sic] injecting front end of the inner tube of the double wall lance, the notches being cut in the axial direction;
injecting the pulverized coal together with a carrier gas through the inner tube at a pulverized coal ratio of 150 kg/t-pig iron or more; and
injecting the combustion-supporting gas through the outer tube of the double wall lance,
wherein the concentration of oxygen in a gas composed of the carrier gas and the combustion-supporting gas is 35% by volume or more and less than 70% by volume and characterized in that
the notches are so formed that the pulverized coal and the combustion-supporting gas can diffuse through the notches and come into contact with each other."

Dependent claims 2 to 24 relate to preferred embodiments.

VII. The patent proprietor's arguments at the appeal stage, where relevant to the present decision, can be summarised as follows.

The main request met the requirements of Article 56 EPC:

- Safety was not to be considered, but the reduction of CO_2 emissions was a central aspect of the problem to be solved.
- The skilled person starting from D7 would not consider the teaching of D3.
- The focus on the lance design for solving the technical problem was proof of hindsight.
- The "combustion efficiency" of the patent in suit and the "burning efficiency" of D3 were not related to each other.
- Even if the skilled person did consider D3, inventive skill was necessary to implement the lance of D3 in the method of D7.

Further arguments are reflected in the reasons below.

VIII. The opponent's arguments at the appeal stage, where relevant to the present decision, can be summarised as follows.

Auxiliary request 3 did not meet the requirements of Article 56 EPC:

- The subject-matter of claim 1 lacked inventive step in view of each of the combinations D7+D3 and D1+D3+D5, the latter document illustrating the common general knowledge.

- The upper O_2 concentration limit added to claim 1 had no technical relevance and was only aimed at creating a distinction from D7. The problem to be solved was to provide a method with increased combustion efficiency.
- Moreover, the patent in suit only contained examples for one very specific experiment set-up and was not representative of the entire breadth of claim 1.
- If the skilled person wished to reduce the oxygen consumption, they would reduce the oxygen concentration.
- D7 taught that high oxygen concentrations led to lance melting.
- D5 taught using pulverized coal with a volatile matter content of 25 mass% or less.
- Claim 1 did not exclude the additional injection of coal with a high volatile matter content.
- The subject-matter of claim 1 also lacked inventive step in view of D3 as the closest prior art.

Moreover, the main request and/or auxiliary request 6 – one of the auxiliary requests which was even more narrowly defined than auxiliary request 3 – did not meet the requirements of Article 56 EPC in view of:

- D1 as the closest prior art in combination with D7 and
- D5 as the closest prior art

Further arguments are reflected in the reasons below.

IX. The opponent requests that the decision under appeal be set aside and the patent be revoked.

The patent proprietor requests that the decision under appeal be set aside and the opposition be rejected. As

an auxiliary measure it requests that the patent be maintained in amended form on the basis of one of the auxiliary requests 3 to 8 submitted with its grounds of appeal.

Reasons for the Decision

1. Main request: inventive step

The main request is identical to the claims as granted.

For the reasons set out below, the subject-matter of claim 1 lacks inventive step in view of a combination of D7 with D3 (Article 56 EPC).

1.1 The invention relates to a blast furnace operation method.

1.2 It has not been disputed that document **D7** is the closest prior art.

D7 (please refer to translation D7T2) discloses a blast furnace operation method (paragraph [0001]).

It has not been disputed that D7 discloses the following features of claim 1 of the main request:

- pulverized coal having a volatile matter content of 25 mass% or less and a coal ratio of 150 kg/t-pig iron or more (claim 1)
- use of a double wall lance with pulverized coal and a carrier gas in an inner tube and a combustion-supporting gas in an outer tube (claim 3)

- oxygen concentration of 35% by volume or more in a gas composed of the carrier gas and the combustion-supporting gas (claim 3)

Since D7 relates to the same technical field and has several features in common with the subject-matter of claim 1, it is indeed an appropriate starting point for assessing inventive step.

1.3 According to the patent in suit, the problem to be solved is to provide a safe operation method with an increased combustion temperature and efficiency and reduced CO_2 emissions, even for coal with a low volatile matter content and a high coal ratio, (paragraphs [0007] to [0010] and [0012] to [0014]).

1.4 The patent in suit proposes solving this problem by means of the operation method of claim 1, characterised by:

- a plurality of notches in an injection front end of the inner tube of the lance
- the notches being cut in the axial direction
- the notches being so formed that the pulverized coal and the combustion-supporting gas can diffuse through the notches and come into contact with each other

The distinguishing features have not been contested either.

1.5 The patent proprietor disputes that the safety aspect is to be considered when formulating the technical problem to be solved since safety is only mentioned in paragraph [0007] of the patent in suit in relation to a single-tube lance arrangement (whereas the closest prior art D7 discloses a double wall lance).

However, this paragraph indicates that safety aspects have to be kept in mind when operating a lance that transports coal and oxygen at high temperatures.

According to the patent in suit, CO_2 emissions are reduced by using pulverized coal (see for example paragraph [0002]). This is, however, already the case in D7 (claim 1). Paragraph [0007] of the patent in suit indicates that CO_2 emissions can be reduced even further if the coal ratio is increased to 170 kg/t. However, claim 1 of the main request is not limited to such high coal ratios. There is thus no evidence for CO_2 emissions that are lower than those of D7.

The technical problem to be solved is therefore reformulated as providing an operation method with an increased combustion efficiency and temperature even when a high ratio of coal with a low volatile matter content is used, the method still being safe and generating only a limited amount of CO_2.

1.6 Figures 9 and 10 of the patent in suit show, for different flow rates, that notches do improve the combustion rate/efficiency for oxygen concentrations in the claimed range. According to paragraph [0027] of the patent in suit, the combustion rate is representative of the combustion temperature.

It is also credible that the claimed notches improve the contact and mixing between coal and oxygen. This has not been disputed.

Moreover, it has not been disputed, nor is there any credible doubt, that the technical problem has been successfully solved.

1.7 Document **D3** is directed to an injection lance of a blast furnace for injecting pulverized coal (page 1, lines 1 and 2).

In claims 2 and 5 and Figures 2 and 3, D3 discloses two preferred alternative and equally likely embodiments.

The embodiment of claim 2 requires slits, which can be axial (as shown in Figure 2) or arranged at an angle (page 5, lines 3 to 13).

The embodiment of Figure 2 discloses a double wall lance with notches cut in the injecting front end and in the axial direction (slits 18). Figure 2 explicitly refers to the "front portion" of the lance (page 4, line 7).

D3 explains (page 3, lines 1 to 17) that these arrangements facilitate flame ignition and improve the stability of the flame and burning efficiency.

The patent proprietor argues that the "burning efficiency" mentioned in D3 (page 3, line 6) relates to the stability of the flame and must not be linked to the combustion efficiency in the technical problem to be solved.

This alleged distinction is artificial and not convincing. Firstly, burning and combustion are considered synonymous in the case in hand. Secondly, the skilled person knows that an unstable flame cannot achieve the same combustion efficiency as a flame in stable, optimised conditions.

The skilled person moreover recognises that stability and easy ignition of the flame are important for safe operation.

The skilled person starting from D7 would therefore consider the teaching of D3 in order to solve the stated technical problem. Selecting the embodiment of Figure 2 with axial slits in the injecting front end (instead of the embodiments in Figure 3 with boreholes and on page 5, lines 9 to 13 with angled slits) is then merely an obvious selection from one of three alternatives (Case Law of the Boards of Appeal, 10th edition, I.D.9.21.9(a)).

1.8 The patent proprietor is of the opinion that the skilled person would not consider D3 since D7 already provides a solution to the stated problem.

There is, however, no reason why the skilled person starting from D7 would be confined to this document when seeking to solve the stated problem.

As shown under point1.7 above, the skilled person is prompted to consider D3.

1.9 The proprietor moreover asserted that inventive skill was necessary to adapt the lance of D3 to the process of D7; the teachings of D7 and D3 were incompatible.

However, as explained above, both D7 and D3 relate to the injection of pulverized coal into blast furnaces.

The proprietor has failed to submit evidence for its assertion, which is not convincing.

1.10 The patent proprietor also argued that exclusively looking for a solution in the field of the lance design, i.e. on the "hardware side", amounted to hindsight.

However, this argument is not convincing either since, as explained above, D7 and D3 relate to the same technical field and D3 discloses a clear incentive to solve the technical problem in the claimed manner.

1.11 Consequently, the subject-matter of claim 1 lacks inventive step (Article 56 EPC) and the main request has to fail.

2. Auxiliary request 3: inventive step

Auxiliary request 3 is identical to auxiliary request 3 considered in the decision under appeal.

As compared with the main request, claim 1 additionally requires that the oxygen concentration is below 70% by volume.

For the reasons set out below, auxiliary request 3 meets the requirements of Article 56 EPC, any admissibility issues related to the objections notwithstanding.

2.1 It has not been contested that **D7** remains an appropriate starting point for assessing inventive step.

2.1.1 The opponent disputed any additional surprising effect related to the new feature in claim 1, be it positive or negative.

Figure 10 of the patent in suit shows that even in the presence of notches, an increase in oxygen concentration beyond 70% results in no further increase in combustion efficiency for a coal ratio above 170 kg/t. Hence, limiting the oxygen concentration under these circumstances to 70% avoids wasting oxygen.

However, claim 1 still also allows for coal ratios between 150 and 170 kg/t, and Figure 9 shows that the combustion efficiency continues to increase in the presence of notches at a coal ratio of 150 kg/t even for oxygen concentrations above 70%.

Hence, limiting the oxygen concentration to 70% does not avoid wasting oxygen over the entire claimed range.

In particular, the opponent disputed any additional surprising effect related to the reduced maximum O_2 concentration in claim 1. In this context, however, the opponent did not counter the patent proprietor's assertion that the maximum oxygen concentration limit did not worsen the combustion efficiency of the method of claim 1 as compared with D7.

2.1.2 There is thus no need to reformulate the problem to be solved as defined for the main request.

The opponent repeatedly confirmed that the problem to be solved was providing a process with increased combustion efficiency.

Again, it has neither been disputed nor is there any doubt that the technical problem has been successfully solved.

2.1.3 With regard to auxiliary request 3, however, inventive step is acknowledged in view of this agreed technical problem.

Even if the skilled person did consider the oxygen concentration to be one of the key parameters of a combustion process, they would not limit the oxygen concentration to less than 70% when starting from D7. On the contrary, D7 teaches away from the claimed solution by requiring an oxygen concentration of *at least* 70% by volume (claim 3, paragraphs [0011] and [0019]).

The same reasoning would apply even if the maximum oxygen concentration had merely been added to claim 1 to further distinguish the subject-matter from D7.

2.1.4 The opponent argues that paragraph [0017] of D7 taught that lance melting occurred at these high oxygen concentrations and that this dissuaded the skilled person from elevated O_2 concentrations.

However, paragraph [0017] of D7 indicates that the problem of lance melting only occurs for coal with a volatile matter content exceeding 25%. D7 therefore instead uses coal with a volatile matter content limited to 25% (claim 1, paragraph [0017]). The problem of lance melting is therefore already mitigated.

2.1.5 In the opponent's view, the patent only contained data for one very specific experiment set-up. Hence, there was certainly no effect present over the entire claimed range.

However, a surprising effect related to the feature added to claim 1 of auxiliary request 3 is not

necessary to acknowledge inventive step, as explained under points 2.1.1 and 2.1.2 above. Moreover, the opponent has failed to submit any experimental evidence for its assertion.

2.1.6 The opponent argued that the skilled person would reduce the O_2 concentration to reduce the oxygen consumption.

However, reducing the O_2 consumption does not correlate with the agreed problem to be solved; the skilled person seeking to increase combustion efficiency/ temperature would in fact try to promote combustion by further increasing the oxygen concentration.

2.1.7 Consequently, the subject-matter of claim 1 involves an inventive step in view of D7, be it alone or in combination with D3 (Article 56 EPC).

The same reasoning applies to the dependent claims (Article 56 EPC).

2.2 Alternatively, the opponent considered **D1** to be the closest prior art when assessing the inventive step of the subject-matter of claim 1 of auxiliary request 3. In its view, a combination of D1 with D3 (for the design features of the lance) and D5 (for the use of coal with a low volatile matter content) resulted in the subject-matter of claim 1 of auxiliary request 3.

The patent proprietor objects to the consideration of this objection but the question of its admissibility can be left unanswered since, as will be shown below, inventive step is acknowledged anyway.

2.2.1 The opponent has not disputed that the technical problem to be solved remains the same as when starting from D7 (see points 1.5 and 2.1.2 above).

2.2.2 The patent in suit proposes solving this problem by means of the operation method of claim 1 characterised by:

- the volatile matter content of the pulverized coal of 25 mass% or less (D1 being silent on the volatile matter content)
- the axial direction of the notches cut in the injecting front end of the inner tube (grooves 24 in Figure 3 of D1 being spiral)
- the notches allowing for the diffusion and contact of the coal and the combustion-supporting gas
- overlapping oxygen concentration ranges: 35% by volume or more and less than 70% by volume according to claim 1 of auxiliary request 3 vs an oxygen enrichment of 1% to 15%, i.e. 22% to 36% oxygen, according to D1 (paragraph [0019] of D1; please refer to translation D1T)

The opponent has not disputed these distinguishing features.

2.2.3 The opponent has also not disputed that the technical problem has been successfully solved.

2.2.4 For the reasons set out below, the claimed solution is not obvious.

- Firstly, paragraphs [0012], [0023] and [0042] as well as Figures 9 and 10 of the patent in suit explain that the claimed lance design (comprising notches) and the claimed oxygen concentration result *in combination* in the beneficial effects -

namely in a high combustion temperature and efficiency - even when using pulverized coal with a low volatile matter content and applying a high coal ratio.

In fact, these effects are achieved because of the improved contact and diffusion of the pulverized coal and the combustion-supporting gas while still within the lance. This results in turn in an increased combustion temperature.

However, the fact that D1 has to be combined with *two* documents, namely with:
- D3 for the lance design and
- D5 for the type of coal with a low volatile matter content

proves under these circumstances that hindsight is necessary to arrive at the subject-matter of claim 1.

- Secondly, D5, which can be considered to illustrate the common general knowledge, generally discloses using pulverized coal with an overlapping volatile matter content of 10 to 35% (page 302, line 11), and specifically using coal types "A" and "B" with volatile matter contents of 37.9% and 13.2%, respectively (page 303, seventh line from the bottom).

However, this is not an unequivocal incentive to use coal with a volatile matter content of 25 mass% or less when starting from the method of D1.

On the contrary, it has not been disputed that coal with a low volatile matter content renders combustion more difficult than coal with a high volatile matter

content. Hence, the skilled person would in fact use coal with a higher volatile matter content to solve the problem of providing increased combustion efficiency.

2.2.5 The opponent also argued that claim 1 did not exclude the additional injection of coal with a high volatile matter content, e.g. through other lances.

However, this argument misses the point that the combination of the features of claim 1 solves the stated problem for a given double wall lance. Other injection lances are of no relevance.

2.2.6 Consequently the subject-matter of claim 1 of auxiliary request 3 also involves an inventive step in view of D1 as the closest prior art (Article 56 EPC).

The same reasoning applies to the dependent claims (Article 56 EPC).

2.3 Auxiliary request 3: consideration of further inventive-step attacks

2.3.1 Even if the opponent was of the opinion that the inventive-step objection starting from **D1** in combination with D7, raised by the opponent in its grounds of appeal against the main request and the even more limited auxiliary request 6, also applied to auxiliary request 3, this objection would not be considered.

No such objection against auxiliary request 3 had been raised at the opposition stage, nor has the opponent provided any reasons for raising it at the appeal stage. This has not been disputed either.

An inventive-step objection starting from D1 in combination with D7 against auxiliary request 3 is therefore disregarded (Article 12(6) RPBA 2020).

2.3.2 In the opponent's view expressed in its grounds of appeal, **D5** represented the common general knowledge and was also an appropriate starting point for assessing the inventive step at least of the subject-matter of claim 1 of auxiliary request 6.

Again, even if the opponent was of the opinion that this inventive-step objection also applied to the (broader) auxiliary request 3, this objection would not be considered.

In this case too, no such objection had been raised at the opposition stage, nor has the opponent provided any reasons for raising it at the appeal stage. This has not been disputed.

An inventive-step objection starting from D5 is therefore disregarded (Article 12(6) RPBA 2020).

2.3.3 In response to the board's communication under Article 15(1) RPBA 2020 and after notification of the summons to oral proceedings, the opponent raised an inventive-step objection starting from **D3** against the subject-matter of claim 1 of auxiliary request 3.

However, the opponent has not provided any cogent reasons justifying exceptional circumstances for doing so at this late stage. This has not been disputed.

Hence, this objection is not considered under Article 13(2) RPBA 2020.

Order

For these reasons it is decided that:

1. The decision under appeal is set aside.

2. The case is remitted to the opposition division with the order to maintain the patent in amended form on the basis of auxiliary request 3 resubmitted with the grounds of appeal of the proprietor and a description to be adapted if necessary.

The Registrar: The Chairman:

C. Vodz E. Bendl

Decision electronically authenticated