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**Datasheet for the decision  
of 28 February 2008**

**Case Number:** T 0357/06 - 3.2.02

**Application Number:** 98121992.6

**Publication Number:** 0918093

**IPC:** C21C 5/52

**Language of the proceedings:** EN

**Title of invention:**  
Coherent jet injector lance

**Patentee:**  
PRAXAIR TECHNOLOGY, INC.

**Opponent:**  
AIR PRODUCTS AND CHEMICALS, INC.

**Headword:**  
-

**Relevant legal provisions:**  
EPC Art. 56

**Keyword:**  
"Inventive step (no)"

**Decisions cited:**  
-

**Catchword:**  
-



Case Number: T 0357/06 - 3.2.02

**DECISION**  
of the Technical Board of Appeal 3.2.02  
of 28 February 2008

**Appellant:** PRAXAIR TECHNOLOGY, INC.  
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**Respondent:** AIR PRODUCTS AND CHEMICALS, INC.  
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**Decision under appeal:** Decision of the Opposition Division of the  
European Patent Office posted 4 January 2006  
revoking European patent No. 0918093 pursuant  
to Article 102(1) EPC.

**Composition of the Board:**

**Chairman:** T. Kriner  
**Members:** D. Valle  
M. Vogel

## Summary of Facts and Submissions

- I. The appellant (patentee) lodged an appeal on 1 March 2006 against the decision of the opposition division posted on 4 January 2006 to revoke the European patent 918093. The fee for the appeal was paid simultaneously and the statement setting out the grounds for appeal was received on 15 May 2006.
- II. The patent was opposed on the grounds of lack of novelty and inventive step (Article 100a EPC). The opposition division held that the subject-matter of all requests then on file did not meet the requirement of Article 54 EPC (lack of novelty) with respect to
- D3 = WO - A - 89/02051.
- III. In addition to the above document the following documents submitted during the opposition proceedings are relevant for the present decision:
- D1 = US - A - 3 427 151  
D11 = BOF Steelmaking, vol. 1, part 1, pages  
522 - 611, The Iron Steel Society, 1982.
- IV. Oral proceedings took place on 28 February 2008.

The appellant requested that the decision under appeal be set aside and that the patent be maintained in amended form according to the main request or to the first or second auxiliary request all filed with the letter of 24 January 2008.

The respondent requested that the appeal be dismissed.

V. Claim 1 of the main request reads as follows:

"Use of a coherent jet injector lance comprising:

(A) an injector assembly having:

(1) a primary passageway, an injection space, and a converging/diverging nozzle having an inlet communicating with the primary passageway and having an outlet communicating with the injection space;

(2) a first secondary passageway radially spaced outwardly from the primary passageway, oriented parallel with the primary passageway and communicating with the injection space flush with the nozzle outlet;

(3) a second secondary passageway radially outwardly spaced from the first secondary passageway, oriented parallel with the primary passageway and communicating with the injection space flush with the nozzle outlet;

and

(B) a jacket covering the injector assembly, said jacket extending past the nozzle outlet for a length of 1,3 to 30,5 cm (0,5 to 12 inches) to define the injection space

for forming a coherent jet of a primary gas stream having a velocity of 304,8 m/s (1000 feet per second) or more, wherein the primary gas which is oxygen is ejected from the primary passageway, oxidant is ejected from the second secondary passageway, fuel is ejected from the first secondary passageway, which oxidant and fuel form annular streams and begin mixing immediately upon ejection and are provided in an amount sufficient to combust to form a flame envelope around the primary gas stream for the length of the primary gas stream, which flame envelope has a velocity less than the

velocity of the primary gas stream, wherein the primary gas stream is introduced into molten metal."

Claim 1 of the first auxiliary request differs from claim 1 of the main request by the additional feature before feature (B):

"(4) each of the first and secondary passageway communicating with the injection space as a ring of holes around the nozzle outlet; and"

Claim 1 of the second auxiliary request differs from claim 1 of the first auxiliary request by the additional feature (at the end of the claim):

"with virtually all of the gas within the coherent jet penetrating the molten metal surface."

VI. The appellant argued as follows:

The subject-matter of claim 1 of the main request differed from the disclosure of D1 in that the nozzle was a converging/diverging nozzle which enabled a velocity of the primary gas stream of more than 304,8 m/s, the jacket extended past the nozzle outlet for a length of 1,3 to 30,5 cm, oxidant was ejected from the second secondary passageway and fuel from the first secondary passageway, and the second secondary passageway communicated with the injection space flush with the nozzle outlet.

It was unjustified to consider the device of D1 as disclosing the feature that the second secondary passageway was flush with the nozzle outlet, since the

external wall of the second secondary passageway continued with the jacket extension and therefore was not on a level with the nozzle outlet.

Furthermore, the provision of any of these features in the lance according to D1 was not obvious. The skilled person would not increase the oxygen speed by means of a Laval nozzle so that it became supersonic, since the physics of a supersonic stream were different to those of a sonic stream. There were also no suggestions in the prior art to reverse the fuel-oxidant order and to select the given range of values for the length of the jacket extension. The claimed arrangement of the fuel and oxidant passageways was advantageous for the formation of the flame envelope and the range of values for the jacket extension had been chosen in order to establish a protecting zone for the gas, as explained in column 4, lines 16 - 22 of the patent specification.

Figure 2 of D1, did not disclose a ring of holes as claimed in claim 1 of the first auxiliary request. The embodiment of Figure 6 did indeed disclose such holes, but not in combination with the further features of the claim. Hence the provision of feature (4) could not be regarded as being obvious.

No comments were made by the appellant concerning the second auxiliary request.

VII. The respondent contested the arguments of the appellant and argued that the subject-matter of claim 1 of all present requests was obvious in the light of the disclosure of D1 together with the general knowledge as supported by D11 and D3.

## Reasons for the Decision

1. The appeal is admissible.
2. *Main request*
  - 2.1 D1 undisputedly discloses (see in particular Figure 2) the use of a coherent jet injector lance comprising:
    - an injector assembly having:
      - a primary passageway (20), an injection space, and a nozzle having an inlet communicating with the primary passageway and having an outlet communicating with the injection space;
      - a first secondary passageway (22) radially spaced outwardly from the primary passageway, oriented parallel with the primary passageway and communicating with the injection space flush with the nozzle outlet;
      - a second secondary passageway (25) radially outwardly spaced from the first secondary passageway, oriented parallel with the primary passageway and communicating with the injection space flush with the nozzle outlet;
    - and
    - a jacket covering the injector assembly, said jacket extending past the nozzle outlet to define the injection space for forming a coherent jet (see column 4, lines 66 - 73) of a primary gas stream having a velocity of 304,8 m/s (see column 7, lines 27 -30, where it is said that the main gaseous treating stream is discharged at high velocity, preferably sonic), wherein the primary gas which is oxygen is ejected from the primary passageway, oxidant is ejected from the

first secondary passageway, fuel is ejected from the second secondary passageway, which oxidant and fuel form annular streams and begin mixing immediately upon ejection and are provided in an amount sufficient to combust to form a flame envelope around the primary gas stream for the length of the primary gas stream (see column 4, lines 71 - 74), which flame envelope has a velocity less than the velocity of the primary gas stream (see column 5, lines 70 - 74, claim 2), wherein the primary gas stream is introduced into molten metal.

2.2 The contention of the appellant that in D1 the second secondary passageway was not flush with the nozzle outlet is not convincing. It is correct that the jacket extension of D1 could be regarded as continuation of the outer wall of the second secondary passageway. However, the jacket extension can also be regarded as circumferential wall of the injections space. While in the first case it is not clear how the outlet of the second secondary passageway is arranged with respect to the nozzle outlet, it is clearly flush with the nozzle outlet in the second case.

2.3 However, D1 does not disclose that:

- i) the first passageway has a converging/diverging nozzle,
- ii) that the length of the extension of the jacket past the nozzle outlet is 1,3 - 30,5 cm, and that
- iii) oxidant is ejected from the second secondary passageway and fuel is ejected from the first secondary passageway, what means that the oxygen and fuel passageways are in reverse order with respect to D1.



2.4 The object underlying the subject-matter of claim 1 with respect to the first distinguishing feature (i) may be regarded as to improve the introduction of the primary gas stream into molten metal.

It is well known to the skilled person that the introduction or rather penetration of an oxygen stream of an injector lance into molten metal is dependent on its velocity. The higher the speed the more penetrating is the stream. Therefore the velocity of the oxygen leaving the lance is typically kept well over 1000 feet per second (304,8 m/s). These well known facts are described for example in D11, page 551, first two paragraphs and the paragraph bridging pages 580 and 582. Since the usual way to increase the velocity of a gas stream to a supersonic speed is the provision of a converging/diverging nozzle (Laval nozzle), the provision of such a nozzle in the injector lance according to D1 in order to achieve the object cited above is obvious.

The appellant's argumentation that the skilled person would not consider the provision of a supersonic stream in the lance of D1, since the physics of such a stream were different is not convincing. D11 explicitly points out that the velocity of an oxygen stream leaving a lance is typically supersonic (well over 1000 feet/second). Hence it is unrealistic to assume that the skilled person would not attempt to use a Laval nozzle in the lance described in D1, in particular since this nozzle could also be used to produce a sonic stream as encompassed by claim 1.

The two further distinguishing features (ii and iii) are merely the result of workshop modifications without any inventive step being involved. The very large range of values for the length of the jacket extension (1,3 - 30,5 cm) cannot be linked with any specific advantage over the unknown length of the jacket extension shown in Figure 2 of D1 which also forms a zone which inevitably protects the gas streams immediately upon their flow out of the primary and secondary passages. Therefore the selection of a length falling in the claimed range does not require an inventive step. Furthermore, as it is recognised in the patent specification itself (see column 3, lines 30 - 40), each of the first and second secondary passageways may communicate with a source of oxidant while the other may communicate with a source of fuel. Hence the reversion of the order of the passageways, albeit less preferable, is an obvious alternative to the claimed order.

Accordingly the subject-matter of claim 1 of the main request does not involve an inventive step.

3. *First auxiliary request.*

The additional feature of claim 1 of the first auxiliary request that each of the first and secondary passageway communicate with the injection space as a ring of holes around the nozzle outlet, is a mere design option which even in the patent in suit is described as a constructive alternative to the case where the first and second secondary passageways communicate with the injection space via a circular annulus (see column 3, lines 56 - 59). These

alternatives are also shown in Figure 2 and 6 of D1 (see additionally column 6, lines 34 - 41).

Certainly the alternatives are shown in different embodiments which do not disclose in combination all the features of claim 1. However the provision of the holes shown in Figure 6 in the embodiment of Figure 2 is only a simple workshop activity which does not require an inventive activity.

Therefore, the subject-matter of claim 1 of the first auxiliary request does also not involve an inventive step.

4. *Second auxiliary request*

The additional feature of claim 1 of the second auxiliary request that virtually the whole gas within the coherent jet penetrates the molten metal surface is known from D1 (see column 4, lines 61 - 71). Therefore, the findings with respect to the first auxiliary request also apply to the second auxiliary request.

**Order**

**For these reasons it is decided that:**

The appeal is dismissed.

The Registrar:

The Chairman:

V. Commare

T. Kriner