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**D E C I S I O N**  
**of 24 February 2004**

**Case Number:** T 0449/02 - 3.2.3

**Application Number:** 94900173.9

**Publication Number:** 0668983

**IPC:** F23L 9/00, F 23G 7/04,  
D21C 11/12

**Language of the proceedings:** EN

**Title of invention:**  
A Furnace

**Patentee:**  
OY Polyrec AB, et al

**Opponent:**  
Kvaerner Pulping Oy

**Headword:**  
-

**Relevant legal provisions:**  
EPC Art. 54, 56

**Keyword:**  
"Novelty - yes"  
"Inventive step - yes"

**Decisions cited:**  
G 0004/93

**Catchword:**  
-



Case Number: T 0449/02 - 3.2.3

**D E C I S I O N**  
of the Technical Board of Appeal 3.2.3  
of 24 February 2004

**Appellant:** OY POLYREC AB  
(Proprietor of the patent) Myllypuront, 26  
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**Representative:** Hoffman Eitle,  
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**Respondent:** Kvaerner Pulping Oy  
(Opponent) Kelloportinkatu 1D  
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**Representative:** Wahl, Hendrik, Dr.-Ing.  
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**Decision under appeal:** Interlocutory decision of the Opposition  
Division of the European Patent Office posted  
2 April 2002 concerning maintenance of European  
patent No. 0668983 in amended form.

**Composition of the Board:**

**Chairman:** C. T. Wilson  
**Members:** U. Krause  
M. K. S. Aúz Castro

## Summary of Facts and Submissions

I. Appeals were lodged by the Proprietor of European Patent No. EP 0 668 983 and by the Opponent against the decision of the Opposition Division dated 26 February 2002 and posted on 2 April 2002 to maintain the patent in amended form. The appeals were submitted concurrently with the payment of the appeal fee on 3 May 2002 (Proprietor) and on 11 June 2002 (Opponent). The statements of the grounds of appeal were received on 17 July 2002 (Proprietor) and on 12 August 2002 (Opponent).

II. The opposition was based on the ground of lack of novelty and inventive step in view of the following prior art:

E1: A. Hjalmarsson, "NO<sub>x</sub> control technologies for coal combustion", IEACR/24 June 1990, IEA Coal Research, pages 32, 33

E2: JP Patent 53-85531 and English translation thereof

E3: US-A-5 007 354 (corresponding to FI-B-85 187)

E4: Tappi Notes "1990 Kraft Recovery Operations Short Course", Helsinki, Finland, August 26-29, 1990, page 194

E5: Tappi Proceedings of the 1992 International Chemical Recovery Conference, Seattle, USA, June 7-11, 1992, Book 1, pages 57,58

E6: US-A-4 469 050

E7: SE-A-9 100 814

The Opposition Division maintained the patent on the basis of an auxiliary request.

III. With the statement of the grounds of appeal the Proprietor (hereinafter denoted Appellant I) submitted three sets of amended claims, one as a main request and two others as auxiliary requests.

With a communication dated 4 April 2003 for preparation of oral proceedings to be held on 12 February 2004 the Board informed the parties of its preliminary opinion on the issue of novelty and inventive step and further pointed to several clarity problems in the amended claims.

The Opponent (Appellant II) withdrew its appeal on 12 January 2004 and its request for oral proceedings on 23 January 2004. Appellant I submitted an amended set of claims of the main request with letter of 23 January 2004 and further amendments to claim 12 of this set with letter of 27 January 2004, both received on 27 January 2004. Thereafter the oral proceedings were cancelled.

IV. The independent claims 1 and 2 of the amended set of claims relating to the main request read as follows:

"1. A black liquor recovery boiler with approximately flat walls and having an approximately rectangular or square cross-section, said black liquor

recovery boiler intended for combustion of black liquor, the oxygen-containing gas supplied as jets, each jet being formed either by one inlet port or by a group of adjacent inlet ports, said jets lying at separate elevation levels whereby all the jets that are vertically located in a height of +/-0.5m are considered jets of the same level, of which levels the two lowest may consist of horizontal or slightly sloping rows of jets,

characterized in that

at levels above the two lowest, the extreme vertical gas flow velocities are reduced and the horizontal mixing improved in the recovery boiler by a few approximately vertical rows of gas jets whereby there are at least three levels above the two lowest in one wall."

- "2. A black liquor recovery boiler with approximately flat walls and having an approximately rectangular or square cross-section, said recovery boiler intended for combustion of black liquor, the oxygen-containing gas supplied as jets, each jet being formed either by one inlet port or by a group of adjacent inlet ports, said jets lying at separate elevation levels whereby all the jets that are vertically located in a height of +/-0.5m are considered jets of the same level, of which levels the two lowest may consist of horizontal or slightly sloping rows of jets,

characterized in that

at levels above the two lowest, the extreme vertical gas flow velocities are reduced and the horizontal mixing improved in the recovery boiler by at least one flat vertical jet the vertical dimension of which at the origin exceeds one meter."

- V. Appellant I requests that the decision under appeal be set aside and the patent be maintained on the basis of the claims of the main request or of any of the auxiliary requests.

The former Appellant II and now Respondent requests that the decision under appeal be set aside and that the patent be revoked.

- VI. The essential arguments of the parties can be summarized as follows:

Appellant I:

The subject-matter of amended claims 1 and 2 of the main request differed from the coal-fired boiler of E1 by being directed to a black liquor recovery boiler, thereby establishing novelty. Since the operating temperatures and, therefore, the processes responsible for NO<sub>x</sub> generation were fundamentally different in the two types of furnaces, E1 was neither a suitable starting point for assessing inventive step nor relevant in this respect.

E3 concerned the same type of furnace as the patent but disclosed two horizontal rows of secondary air jets and two horizontal rows of tertiary air jets, each in opposite walls, thereby falling short of teaching to reduce vertical gas flow velocities and to improve the horizontal mixing by a few approximately vertical rows of gas jets. The mentioned desired effect could not be achieved with the nozzle arrangement of E1 which resulted in a rotating fire-ball arrangement in the centre of the boiler, reducing peak temperatures but maintaining a hot, fuel-rich central core with high vertical flow velocities. E4 and E5 corresponded to E3 as regards the different, undefined levels of horizontal rows for secondary and tertiary air jets in opposite walls.

A flat vertical jet as defined in claim 2 was not derivable from any of the cited prior art.

Respondent:

Document E3, being the most relevant state of the art after the amendment of claims 1 and 2, disclosed a black liquor recovery boiler comprising, as shown in Figure 6, two vertical rows each comprising two gas jets (11,13) on the front wall and two similar vertical rows on the rear wall for the secondary air supply. Adding the same number of jets for the corresponding tertiary air supply would increase the number of jets or levels in each vertical row to four. These levels are above the two lowest for the primary air supply, and may have any convenient vertical spacing, including the definition of the levels in claim 1. It was clear in particular from column 2, lines 14 to 19, that the

same effect of reducing vertical flow velocity and improved horizontal mixing was achieved.

Replacing the aligned vertical rows of jets by a single flat vertical jet, as defined in claim 2, was obvious as relating to an equivalent solution, apart from being suggested by Figure 16 of E1.

The further features defined in the auxiliary requests were likewise known from E3 or obvious. The staggered and either symmetric or asymmetric arrangement of the jets at one level could be derived from Figure 6 of E3, depending on how many ports were added on each side, and a staggered jet arrangement was shown in Figure 2 of E5 for the same purpose of avoiding collision of the jets and creating a uniform vertical velocity profile.

## **Reasons for the Decision**

### *1. Admissibility of appeals and requests*

The appeal of Appellant I complies with the provisions of Articles 106 to 108 EPC and of Rules 1(1) and 64 EPC and is, therefore, admissible. Since former Appellant II has withdrawn its appeal the admissibility of its appeal need not be checked.

Since Appellant I remains as sole Appellant former Appellant II, having become a party to the appeal proceedings as of right under Article 107 EPC, second sentence, may not challenge the maintenance of the patent as amended by the interlocutory decision (see G 4/93, OJ 1994, 875, point 14). Likewise, the Board



has no competence to put into question the maintenance of the patent according to the decision under appeal because this amended text is not covered by Appellant's I appeal request which, after the withdrawal of Appellant's II appeal, determines the scope of the remaining appeal (see G 4/93, *supra*). Consequently, the auxiliary requests of Appellant I, corresponding essentially to the claims as maintained (first auxiliary request) or with even further restrictions (second auxiliary request), as well as the arguments of the former Appellant II and now Respondent concerning the allowability of the claims of the patent as maintained, will not be taken into account. The only issue to be decided is, therefore, whether or not the grounds of opposition prejudice the maintenance of the patent on the basis of the Appellant's main request.

2. *Admissibility of the opposition*

Following an objection of Appellant I as to non-admissibility of the opposition the Opposition Division held, in the decision under appeal (see point 1 of the reasons), that the opposition complied with the provisions of Rule 55(c) and was, therefore admissible. Appellant I did not raise this objection again during the appeal proceedings and the Board, having duly considered this matter, is in agreement with the finding of the Opposition Division.

3. *Disclosure*

Compared with the patent as granted, the furnace claimed in amended claims 1 and 2 was further defined as being a black liquor recovery boiler intended for

combustion of black liquor. A basis for this amendment is found in the description of the relevant prior art of combusting spent liquors or black liquor from pulping processes and the associated problems to be solved by the invention, as set out on pages 1 to 4 of the application as published, in the "application example" concerning a black liquor recovery boiler, as described on page 8 of the application as published, and in the short description of Figure 8, incorporating the abstract of the published application which referred to spent liquors of the pulp industry. Clarifications corresponding to this limitation have been made in claims 11 and 12.

Thus, the claims of the main request are not open to objection under Articles 123(2) and (3) EPC.

4. *Novelty*

4.1 It is no longer disputed that the subject-matter of claims 1 and 2, after limitation to a black liquor recovery boiler, is not known from document E1. In fact, this limitation not only concerns an intended use but defines a difference from a coal-fired furnace, as disclosed in E1, for example with respect to fuel supply arrangements involving, in the case of a black liquor, nozzles for spraying or injecting the liquor into the boiler as compared with, in the case of a coal-fired furnace, a burner firing the boiler. Thus, it can be left undecided, for the issue of novelty, whether the secondary air ports as shown in Figure 16 of E1 meet the definition of vertical rows and levels given in claim 1.

4.2 The Respondent, therefore, has based a novelty attack on document E3, arguing essentially that the embodiment of Figure 6 comprises vertical rows of gas jets, in at least three levels, formed by two vertically spaced ports 11,13 of the secondary air supply S1, S2 and corresponding two ports of the tertiary air supply T1, T2, for the same purpose of reducing the vertical gas flow velocities and improving the horizontal mixing.

4.3 Document E3 is concerned with the problem of unsatisfactory combustion of black liquor in a furnace having air inlet ports arranged in horizontal rows of the same height and producing colliding air jets and a powerful upward flow in the centre of the combustion chamber (c.f. the chapter headed "background of the invention" in column 1).

As outlined in column 2, lines 11 to 19, and column 4, lines 16 to 21 and 49 to 55, this problem is solved by staggering the gas jets for the air supply in opposite walls in horizontal and vertical direction such that a jet coming from one wall does not impinge on a jet coming from the opposite wall. It can be derived especially from Figures 2 to 6 and from the text bridging columns 4 and 5 that the inlet ports for providing the gas jets of the secondary air supply are arranged in arrays S1,S2 along a horizontal line with fixed intervals, thereby forming horizontal rows. In Figure 6 there are two such horizontal rows on top of each other. If a similar arrangement was selected for the tertiary air supply, as indicated in column 4, lines 46 to 49, the secondary and tertiary air supply would comprise four horizontal arrays or rows of air inlet ports on the opposite walls of the boiler above

the two horizontal rows for the primary air supply P1,P2 at the bottom of the boiler.

- 4.4 This configuration does not correspond to the "few approximately vertical rows of gas jets" including at least three levels each of which may span a height of +/-0.5m, as defined in claim 1 of the patent.

In fact, the term "vertical row of gas jets" defines, according to the normal understanding confirmed in the patent, for example in the text in column 4, lines 7 to 21, and by the embodiment of Figure 8, a large number of substantially uniformly spaced and vertically aligned gas jets. It is, however, not unambiguously derivable from E3 that the two horizontal rows for the tertiary air supply are or should be vertically aligned with the horizontal rows for the secondary air supply shown in Figure 6, and a maximum of four vertically spaced inlet ports do not count as such a large number making up a row. Further, no information is available in E3 about the vertical spacing between the upper horizontal row of the secondary air supply and the lower horizontal row of the tertiary air supply in relation to the vertical spacing between both rows of the secondary and tertiary air supply, respectively. Considering Figure 1 it appears that the distance in vertical direction between the inlet ports for the secondary air supply S and for the tertiary air supply T is by far greater than the distance between both horizontal rows of the secondary and the tertiary air inlet ports, leading to a grossly nonuniform spacing of these ports in the vertical direction.

Moreover, there is a lack of information in E3 about the number of inlet ports in one horizontal row since the Figures 2 to 6 do not show a complete row. Judging by the corresponding inlet ports (8) for the primary air supply shown in Figure 1 the number seems to be higher than "a few".

It is further noted that no relation of the aligned levels to the levels defined in claim 1, either to the effect that jets S1 and S2, as well as jets T1 and T2, belong to the same level or that they should be in different levels, whereby the vertical extension of a level is +/-0.5 m, i.e. 1 m, can be derived from either the text or the drawings of E3. It may be convenient to choose a spacing of more than 1m between the horizontal rows of jets S1,S2 or T1,T2, as argued by the Respondent, but the mere possibility to choose such a value cannot serve as a substitute for a clear teaching to do so.

4.5 Since a boiler as defined in claim 1 cannot be derived from the remaining prior art either, the subject-matter of the independent claim 1 is considered to be new in the sense of Article 54 EPC.

4.6 As to independent claim 2, a novelty objection was raised neither in the decision under appeal nor by the Respondent. Since the supply of the oxygen-containing gas in the form at least one flat vertical jet cannot be derived from any of the available documents, the subject-matter of claim 2 is likewise considered to meet the requirement of Article 54 EPC.

5. *Inventive step*

- 5.1 It is common ground that, after amendment of claims 1 and 2, document E3 represents the closest prior art. As set out *supra* (see point 4.3), the secondary and tertiary combustion air for the boiler of E3 is supplied through a number of horizontal rows of inlet ports disposed in opposite walls of the boiler in a horizontally and/or vertically staggered manner so that the air flows or jets issued from the inlet ports bypass each other without colliding with each other. It is pointed out in column 2, lines 14 to 19, that "this prevents the formation of powerful resultant flows and the flue-gas flow directed upwards from the region of the secondary-air ports is substantially more peaceful and uniform over the entire horizontal cross-surface area of a combustion chamber".
- 5.2 The patent in suit is also concerned with a reduction of the vertical gas flow velocities and an improved horizontal mixing in the combustion chamber so as to obtain a complete and stable combustion of black liquor with low NO<sub>x</sub> and SO<sub>x</sub> content in the flue gas and lower carry-over of fuel particles (c.f. the chapter headed "Problems" in columns 2 and 3 of the patent). It was found that the horizontal rows of the gas inlet ports, whether staggered or not, were unfavourable by generating vertical recirculation flows of entrained furnace gases above and below the rows of inlet ports, enhancing vertical mixing rather than horizontal mixing, and that the desired horizontal mixing with stronger vertical temperature and concentration gradients could be obtained by rotating the flow pattern by 90 degrees, replacing the horizontal rows of gas jets by a few

vertical rows causing horizontal recirculation flows (see column 4, lines 7 to 21). As set out *supra* (see point 4.4) it is evident from this description that the concept of "a few vertical rows of gas jets", which is claimed in claim 1, involves a relatively large number, compared to the conventional number of levels of inlet ports in horizontal rows, of uniformly spaced jets in a vertical row. The same effect concerning the flow pattern in the combustion chamber is produced by the at least one flat vertical jet claimed in claim 2.

5.3 It will therefore have to be determined whether it was obvious for a skilled person to replace the arrangement of the horizontal rows of inlet ports disclosed in E3 by a few vertical rows of gas jets or a flat vertical jet with a view to improve the combustion of black liquor in the boiler.

5.4 Document E1 is the only document referred to by the Respondent and in the decision under appeal as disclosing an arrangement of vertical rows of air inlet ports. In fact, Figure 16 of E1 shows two embodiments, an unmodified unit on the left and a modified unit on the right, both comprising a vertical interleaved configuration of coal and oil burners and secondary air inlet ports. Since it is evident from the text on page 33 of E1 that this combination of burners and air inlet ports serves the purpose of generating a staged combustion of coal in a central rotating "fireball" zone or "fuel-rich" zone of the furnace, as depicted in the centre of Figure 16, the air inlet ports and fuel burners are clearly correlated and the skilled person would have no reason to apply such an arrangement to a black liquor recovery boiler as disclosed in E3, having

an inlet (6) for the black liquor but neither any staged combustion nor any further fuel burners. The formation of the central fireball or fuel-rich combustion zone, implying large horizontal temperature and concentration gradients, would further discourage the skilled person to consider this document for improving horizontal mixing in the black liquor recovery boiler of E3.

Moreover, it cannot be derived from E1 how the arrangement of the burners and air inlet ports affects the vertical gas flow velocities in the furnace but any effect would be due to the combined action of burners and air jets issued from the air inlet ports, rather than to the arrangement of the air jets as such. With regard to this arrangement it is further observed that neither of the embodiments of E1 has a vertical row of gas jets in the sense of claim 1, involving, as set out above, a large number of uniformly spaced gas jets, since the unmodified unit comprises only four inlet ports and the inlet ports of the modified unit are not uniformly spaced.

It is, therefore, concluded that a skilled person would not take document E1 into consideration for improving the combustion in a black liquor recovery boiler, and if he nevertheless did so he would not arrive at the subject-matter of claim 1 of the patent in suit. Regarding claim 2 there is no indication in E1 of a flat vertical air jet having a vertical dimension of more than one meter, and such a flat jet would not be an obvious modification as being incompatible with the interleaved air inlet port and burner configuration of E1.



The now Respondent referred to document E5 with respect to the auxiliary requests only. It is observed that this document as well as document E4 discloses different arrangements of staggered horizontal rows of gas jets, as in E3, and that neither these documents nor the remaining prior art disclose the injection of combustion air into a furnace in the form of either a vertical row of gas jets or a flat vertical gas jet.

- 5.5 The subject-matter of claims 1 and 2 is, therefore, considered as involving an inventive step in the sense of Article 56 EPC.
  
6. Consequently, the grounds of opposition, lack of novelty and inventive step, do not prejudice the maintenance of the patent on the basis of the main request.

**Order**

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

1. The decision under appeal is set aside.
2. The case is remitted to the first instance with the order to maintain the patent as amended in the following version:

Claims:           No. 1 to 11 filed with the letter of  
                          23 January 2004  
                          No. 12 filed with the letter of  
                          27 January 2004

Description:      Pages 1 to 4 of the patent specification

Drawings:         Sheets 1 to 3 (Figures 1 to 8) of the  
                          patent specification

The Registrar:

The Chairman:

A. Counillon

C. T. Wilson