

BESCHWERDEKAMMERN  
DES EUROPÄISCHEN  
PATENTAMTS

BOARDS OF APPEAL OF  
THE EUROPEAN PATENT  
OFFICE

CHAMBRES DE RECOURS  
DE L'OFFICE EUROPEEN  
DES BREVETS

**Internal distribution code:**

- (A)  Publication in OJ
- (B)  To Chairmen and Members
- (C)  To Chairmen

**D E C I S I O N**  
of 21 July 1998

**Case Number:** T 0097/95 - 3.3.1

**Application Number:** 87301138.1

**Publication Number:** 0233076

**IPC:** C07C 29/151

**Language of the proceedings:** EN

**Title of invention:**  
Process for the production of synthesis gas

**Patentee:**  
FOSTER WHEELER ENERGY LIMITED

**Opponent:**  
Imperial Chemical Industries PLC

**Headword:**  
Synthesis gas production/FOSTER WHEELER

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

**Keyword:**  
"Inventive step (yes) - non-obvious solution of the technical problem underlying the patent in suit"

**Decisions cited:**  
-

**Catchword:**



Europäisches  
Patentamt

European  
Patent Office

Office européen  
des brevets

Beschwerdekammern

Boards of Appeal

Chambres de recours

Case Number: T 0097/95 - 3.3.1

**D E C I S I O N**  
of the Technical Board of Appeal 3.3.1  
of 21 July 1998

**Appellant:**  
(Opponent)

Imperial Chemical Industries PLC  
Imperial Chemical House, Millbank  
London SW1P 3JF (GB)

**Representative:**

Gratwick, Christopher  
Intellectual Property Department  
ICI Chemicals & Polymers Ltd.  
P.O. Box 11  
The Heath  
Runcorn  
Cheshire WA7 4QE (GB)

**Respondent:**  
(Proprietor of the patent)

FOSTER WHEELER ENERGY LIMITED  
Foster Wheeler House  
Station Road  
Reading  
Berkshire, RG1 1LX (GB)

**Representative:**

Rackham, Anthony Charles  
Lloyd Wise, Tregear & Co.  
Commonwealth House  
1-19 New Oxford Street  
London WC1A 1LW (GB)

**Decision under appeal:**

Interlocutory decision of the Opposition Division  
of the European Patent Office posted  
2 December 1994 concerning maintenance of  
European patent No. 0 233 076 in amended form.

**Composition of the Board:**

**Chairman:** A. J. Nuss  
**Members:** J. M. Jonk  
R. E. Teschemacher

### Summary of Facts and Submissions

I. The Appellant (Opponent) lodged an appeal against the interlocutory decision of the Opposition Division by which the European patent No. 0 233 076 (European patent application No. 87 301 138.1) was maintained in amended form.

II. The decision was based on Claim 1 as submitted during the oral proceedings before the Opposition Division on 23 November 1994 as main request and Claims 2 to 15 as granted. Claim 1 read as follows:

"A process for producing an organic compound from a hydrocarbon containing feedstock, which comprises:

- a) dividing the feedstock into two fractions,
- b) subjecting a first fraction from (a) to a primary steam reforming reaction, by mixing the fraction with steam and heating the mixture thereof by indirect heat exchange, in the presence of a reforming catalyst, to form a gaseous effluent including hydrogen at a temperature from 650° to 850°C,
- c) mixing the gas effluent from (b) with the second fraction from (a),
- d) reacting in a single stage the gas mixture from (c) with a free oxygen-rich gas, in a secondary reforming reactor operating under essentially adiabatic conditions, and containing a single bed of catalyst, thus producing a synthesis gas at a temperature from 850° to 1250°C, containing a percent methane equivalent of less than one-tenth of that of the gas mixture

from (c), and having a Z ratio of from 0.80 to less than 1.00, where Z is defined as:

$$Z = \frac{\text{moles H}_2}{2(\text{moles CO}) + 3(\text{moles CO}_2)}$$

e) mixing the gas effluent from (d) with a hydrogen-rich stream free from carbon oxides to form a final synthesis gas stream,

f) injecting the final synthesis gas from (e) into a synthesis loop, forming the organic compounds in the loop, and extracting from the loop a purge gas stream,

g) separating the purge gas stream from (f) in a physical separation to form a hydrogen-rich gas stream free from carbon oxides and a residual gas stream,

h) recycling at least a portion of the hydrogen-rich gas stream from (g) to step (e)."

III. The opposition was based on the grounds that the patent in suit did not comply with the requirements of Article 100(a), (b) and (c) EPC, in particular Articles 52, 56, 83 and 123(2) EPC, and supported by the following documents:

- (1) GB-A-1 569 014,
- (2) EP-A-0 123 534,
- (3) EP-B-0 047 596, and
- (4) US-A-4 203 915.

IV. The Opposition Division held that the subject-matter of said claims met the requirements of Articles 83 and 123(2) EPC, was novel and involved an inventive step.

Concerning inventive step they held that in the light of the closest state of the art, i.e. document (1), the technical problem underlying the patent in suit was the provision of a process for the preparation of organic compounds, such as methanol, allowing a reduction of investment costs. Moreover, they considered that the solution of this technical problem in accordance with Claim 1, in particular by (i) reducing the size of the steam reformer giving a hydrogen deficiency in the synthesis gas feed and (ii) recycling at least a portion of the hydrogen-rich gas stream free from carbon oxides (step h) as separated from the purge stream (step g) extracted from the synthesis loop (step f) in order to compensate for said hydrogen deficiency, could not be derived from the cited prior art.

- V. Oral proceedings were held on 21 July 1998, whereby both the Appellant and the Respondent, as announced by their letters dated 10 and 13 July 1998 respectively, were not represented.
- VI. The Appellant argued in writing that the subject-matter of the present claims did not involve an inventive step in the light of document (1) in combination with documents (2), (3) and/or (4). In particular, he argued that the preparation of a synthesis gas feed having a hydrogen-deficiency with respect to the production of methanol, i.e. having a Z-value of less than 1, was known from document (1), and that a skilled person would have acknowledged that the preparation of such a hydrogen-deficient synthesis gas would allow a significant reduction of the size and the costs of the steam reformer and thus of the overall plant. Moreover, he argued that, in the light of documents (2) to (4), it would have been obvious to a skilled person that the composition of a hydrogen-deficient synthesis gas feed

could be corrected for the preparation of methanol by recycling a hydrogen-rich gas stream in accordance with present Claim 1. In this context, he emphasised that it could be derived from document (1) that the preparation of the organic compounds was carried out in a synthesis loop and that it was obvious to the skilled person that this inevitably would involve the use of a purge in order to avoid a build-up of both methane and nitrogen.

Furthermore, he contended by referring to three additional documents, namely

- (5) "Chemical Engineering", October 10, 1977, pages 90 to 92,
- (6) US-A-4 296 085, and
- (7) "Chemical Economy & Engineering Review", Vol. 16, No. 9, September 1984, pages 36 and 37,

that the recycling of a hydrogen-rich gas in order to compensate for a hydrogen-deficiency of a synthesis gas was also well known in the analogous field of the production of ammonia.

VII. The Respondent (Proprietor of the patent in suit) defended the patentability of the subject-matter of the present claims essentially in accordance with the decision of the Opposition Division. He argued in particular that document (1) only disclosed the preparation of synthesis gas feeds having each time the right stoichiometry for the particular application, so that this document did not give any incentive to a skilled person to produce a hydrogen-deficient synthesis gas feed, let alone to produce such a feed by reducing the size of the steam reformer, and to correct the stoichiometry of said feed by recycling a hydrogen-rich gas stream as claimed. Furthermore, he emphasised that a skilled person did not have any reason to take

the prior art as disclosed in documents (2) to (7) into consideration, since in the light of the closest state of the art as represented by document (1) a hydrogen-deficiency problem did not exist.

VIII. The Appellant requested in writing that the decision under appeal be set aside and that the patent be revoked.

The Respondent requested that the appeal be dismissed.

IX. At the conclusion of the oral proceedings the Board's decision was pronounced.

#### **Reasons for the decision**

1. The appeal is admissible.
2. The Board concurs with the findings of the Opposition Division that there are no formal objections to the present claims under Article 123 EPC and that the subject-matter of present Claim 1 also meets the requirements of Article 83 EPC. The Appellant did not raise objections anymore with respect to these issues and the Board sees no reason to disagree. Therefore, it is not necessary to give detailed reasons in this respect.
3. After examination of the citations on file, the Board has reached the conclusion that the subject-matter as defined in all claims is novel. Since this issue was not in dispute, it is also not necessary to give detailed reasons for this finding.

- 4. The remaining issue to be dealt with is whether the subject-matter of the present claims involves an inventive step.
  
- 4.1 In this respect, the Board concurs with the findings of the Opposition Division concerning the identification of the "closest prior art", the definition of the technical problem to be solved as the object of the invention, and the characterising features of the claimed solution to this technical problem (see under point IV above). These findings have not been disputed by the parties.
  
- 4.2 In assessing inventive step, the question thus is whether the cited prior art would have suggested to a skilled person in the art solving the defined technical problem, i.e. the provision of a process for the preparation of organic compounds, such as methanol, allowing a reduction of investment costs, in the proposed way.
  
- 4.3 Document (1) relates to a process for producing a synthesis gas having a composition adjustable at will, but in particular equal to the stoichiometric composition required for methanol synthesis, comprising essentially dividing the feedstock into two fractions, reacting the first fraction with steam in a steam reformer, mixing the second fraction with the gas effluent from the steam reformer, and reacting the mixture so obtained with oxygen in a second reformer, whereby the composition of the gas effluent from the second reforming step is adjusted in such a way that it is as close as necessary to the stoichiometric composition required for methanol synthesis or for another purpose (see page 2, lines 20 to 24 and 32 to 41, the examples, and Claim 1).

- 4.4 The Appellant argued that this document (1) clearly disclosed that a partial bypass of the steam reformer allowed a significant reduction of the throughput of the steam reformer rendering it possible to decrease the size thereof and consequently the investment costs.

In this context, he emphasised that a comparison of Example 1 with Example 5 of document (1) also showed that a further significant reduction of the throughput of the steam reformer allowing an additional saving of investment costs could be achieved by producing a slightly hydrogen-deficient synthesis gas, and that a skilled person would know e.g. from documents (2) to (4) that such a hydrogen-deficiency of the synthesis gas could be corrected by separating and recycling a hydrogen-rich gas from the synthesis loop.

Furthermore, he contended that a skilled person would appreciate that, despite the Example 5 being said to be suitable for applications other than methanol synthesis, a synthesis gas obtained by using a feedstock bypass proportion between the proportions of Examples 1 and 5, meeting the required minimum CO<sub>2</sub> content of at least 3% by volume, could be used for methanol synthesis, and that the use of such a gas also would have the advantage of considerable savings in the size and cost of the steam reformer.

- 4.5 The Board agrees with the Appellant that it can indeed be derived from document (1) that one of the advantages with respect to the conventional process for producing methanol synthesis gas, involving only steam reforming and not a secondary oxygen reforming, was the reduction of the cost of the steam reformer.

However, document (1) clearly discloses that **the main objective** of the process as presented in this document as the invention was the provision of a synthesis gas having a substantially **stoichiometric composition** required for methanol synthesis, or for another purpose, in order to overcome the drawbacks relating to the non-stoichiometric prior art compositions, such as the obligation to purge large quantities of hydrogen from the synthesis loop (see page 2, lines 48 to 51 and lines 20 to 24, and page 1, line 35 to page 2, line 4). In addition, it discloses that when producing a methanol synthesis gas, one is aiming on the one hand to obtain a **stoichiometric gas composition**, and on the other hand to have a **minimum CO<sub>2</sub> content** in the final gas compatible with the methanol synthesis process used downstream (i.e. **at least 3% by volume** in the low pressure synthesis), and that **this is a controlling factor in selecting the steam/carbon ratio in the steam reforming step and the relative split of the feedstock between the two fractions** (see page 4, lines 19 to 24).

Therefore, having regard to the teaching of document (1) as a whole that the provision of a synthesis gas having a stoichiometric composition for the synthesis of methanol (or for another purpose) is an **essential feature**, and that the amount of the feedstock fraction reacted in the steam reformer, i.e. the throughput of the steam reformer, is an important factor to achieve this, a skilled person trying to solve the technical problem underlying the patent in suit would certainly not derive any pointer from this document to produce a hydrogen-deficient, non-stoichiometric synthesis gas composition by reducing the throughput of the steam reformer, let alone to correct said composition by recycling a hydrogen-rich gas in accordance with the patent in suit.

4.6 Regarding the Appellant's submissions with respect to the examples of document (1) the Board notes that a skilled person would not have any reason to make the comparison suggested by the Appellant between the process for producing synthesis gas in accordance with Example 1 and that of Example 5, since Example 1 concerns a process for producing a substantially stoichiometric synthesis gas composition for methanol synthesis, whereas Example 5 relates to a process for preparing a synthesis gas having a composition for a totally different purpose, namely the direct reduction of iron ore, which composition - as admitted by the Appellant - is not suitable for methanol synthesis due to its low CO<sub>2</sub> content of less than 3% by volume (see document (1), page 4, lines 39 to 44 and 53 to 61, as well as the Table on page 6, and Appellant's letter dated 24 March 1995, page 5, paragraphs 2 and 3).

Furthermore, Appellant's submission that the claimed solution of the present technical problem would have been obvious in the light of document (1), because a skilled person would have appreciated that a synthesis gas obtained by using a feedstock bypass proportion between the proportions of Examples 1 and 5 could be used for methanol synthesis, and that the use of such a gas would have the advantage of considerable savings in the cost of the steam reformer, cannot be accepted by the Board, since the use of such a feedstock bypass proportion would have required a synthesis gas having a substantially stoichiometric composition for methanol synthesis falling under the scope of the teaching of document (1) and rendering any recycling of a hydrogen-rich gas redundant.

4.7 Documents (2) to (7) were cited by the Appellant in order to show that it was well known that a hydrogen-deficiency of a synthesis gas to be used for different

purposes, such as methanol synthesis, could be corrected by recycling a hydrogen-rich gas as separated from a synthesis loop.

However, as indicated above, a skilled person, faced with the technical problem underlying the patent in suit, would not have any reason to modify the process of document (1), i.e. in particular the preparation of a synthesis gas having a stoichiometric composition for its particular purpose. Therefore, in the light of the closest prior art represented by document (1), there did not exist a problem of a hydrogen-deficiency at all, so that the skilled person would not have any reason to take the documents (2), to (7) into consideration.

In this context, the Board observes that document (1) disclosing the preparation of methanol using a synthesis gas having a stoichiometric composition of course does not suggest the possibility of purging an excess of the hydrogen reactant.


- 4.8 In conclusion, the Board finds that the process according to present Claim 1 involves an inventive step as required in accordance with Article 56 EPC.

Since Claims 2 to 15 relate to particular embodiments of the subject-matter of Claim 1, they are also admissible.


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

The appeal is dismissed.

The Registrar:

  
E. Görgmaier

The Chairman:

  
A. Nuss

