BESCHWERDEKAMMERN DES EUROPÄISCHEN PATENTAMTS

BOARDS OF APPEAL OF THE EUROPEAN PATENT OFFICE

CHAMBRES DE RECOURS DE L'OFFICE EUROPEEN DES BREVETS

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File Number: T 0055/92 - 3.3.1

Application No.: 84 201 844.2

Publication No.: 0 150 533

Title of invention: Process and apparatus for the production of synthesis gas

Classification: C10J 3/46

D E C I S I O N
of 8 June 1993

Proprietor of the patent: SHELL INTERNATIONALE RESEARCH MAATSCHAPPIJ B.V.

Opponent: Krupp Koppers GmbH

Headword: Synthesis gas/SHELL

EPC Art. 56 and 123(2)

Keyword: "Inventive step (confirmed); after amendent; return to concept regarded as superceded"

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Beschwerdekammern | Boards of Appeal | Chambres de recours

Case Number : T 0055/92 - 3.3.1

D E C I S I O N
of the Technical Board of Appeal 3.3.1
of 8 June 1993

Appellant : (Proprietor of the patent)
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Decision under appeal : **Decision of the Opposition Division of the European Patent Office of 15 October 1991, with written reasons posted on 22 November 1991, revoking European patent No. 0 150 533 pursuant to Article 102(1) EPC.**

Composition of the Board :

Chairman : K.J.A. Jahn
Members : R.W. Andrews
J.A. Stephens-Ofner

Summary of Facts and Submissions

I. European patent No. 0 150 533 in respect of European patent application No. 84 201 844.2, which was filed on 12 December 1984, was granted on 5 April 1989 (cf. Bulletin 89/14).

II. A notice of opposition, which was filed on 21 December 1989, requested the revocation of the patent on the grounds that its subject-matter lacked novelty and did not involve an inventive step. The opposition was supported, *inter alia*, by the following documents:

(2) DE-B-1 023 549 (equivalent to GB-A-837 307 (2a))
(3) DE-B-1 080 253 (equivalent to GB-A-793 466 (3a)).

III. By a decision issued orally on 15 October 1991, with written reasons being issued on 22 November 1991, the Opposition Division revoked the patent. The Opposition Division held that the subject-matter of the amended Claim 1 did not involve an inventive step in the light of the disclosure of documents (2) and (3). The Opposition Division considered that the subject-matter of this claim only differed from that of document (3) in that the temperature of the synthesis gas in the cooled tube and the inlet and outlet temperatures of the coolant were specified. However, these temperatures were regarded as being usual in the art.

IV. An appeal was lodged against this decision on 10 January 1992 with payment of the prescribed fee. In his Statement of Grounds of Appeal filed on 14 March 1992 and during the oral proceedings held on 8 June 1993, the Appellant emphasised that the cooled tube with the smooth inner wall of the present process has a different

technical function to that of the radiation boiler of document (3). The Appellant contended, and attempted to prove by means of a calculation based on the example of the disputed patent, that the gas flow in this cooled tube was laminar and due to the presence of a laminar boundary layer the transfer of heat was by conduction. However, in the case of the radiant boiler of document (3) there was turbulent flow in at least part of it and this resulted in heat transfer by convection.

The Appellant submitted that the present invention was based on a combination of cooling and recovery of heat in a waste heat boiler, whereas documents (2) and (3) disclosed the recovery of heat in two stages by splitting the radiation boiler of a conventional process into two parts.

Finally, the Appellant argued that from the discussion of the prior art disclosed in document (2) the skilled person would be discouraged from even considering the present solution to the technical problem underlying the disputed patent.

V. The Respondent denied that it was possible to determine from the example of the disputed patent whether the gas flow was laminar or not. Therefore, Claims 1 and 6 of the Appellant's first auxiliary request were unallowable under Article 123(2) EPC.

With respect to the main request, the Respondent contended that, in the light of the combined teaching of documents (2) and (3), the differences between the present process and that of document (1) cannot render the claimed process inventive. In connection with the secondary auxiliary request, the Respondent contended that, since, in the granted patent, cooled tubes having

uniform and varying diameters were disclosed as being equivalent to each other, the restriction to a tube having a uniform diameter was not sufficient to render the subject-matter of this request inventive. He submitted that the claimed process and those of documents (2) and (3) were essentially the same, only the hardware of the claimed process was less complicated than that of the prior art processes.

VI. The Appellant requested that the decision under appeal be set aside and that the patent be maintained on the basis of the amended Claims 1 and 6 submitted on 14 March 1992 and Claims 2 to 5 and 7 to 9 as granted. As auxiliary requests 1 and 2, the Appellant requested that the patent be maintained on the basis the two Claims 1 and 6 submitted during oral proceedings and Claims 2 to 5 and 7 to 9 as granted.

Claims 1 and 6 of the main request read as follows:

"1. A process for the production of synthesis gas wherein:

a) a finely divided carbonaceous fuel is partially combusted with an oxygen-containing gas at elevated temperature and pressure in a gasification reactor, yielding liquid slag and synthesis gas;

b) part of the liquid slag is removed from the bottom of the gasification reactor;

c) hot crude synthesis gas containing entrained slag droplets leaves the top of the gasification reactor and is removed from the top of the gasification reactor to a waste heat boiler;

d) the crude synthesis gas is passed downwards through the said waste heat boiler to cool it further;

e) the cooled synthesis gas is removed from the lower part of the said waste heat boiler,

characterized by the following steps:

f) the said hot crude synthesis gas leaving the top of the gasification reactor is passing upwards at an average linear velocity ranging from 4 to 40 m/s through a single connection tube with a smooth inner wall, said single tube connecting the top outlet of said reactor to the waste heat boiler which as a whole is located adjacent or next to said reactor;

g) along at least a part of the said single connection tube a coolant is passed in indirect heat exchange with the crude synthesis gas so that the crude synthesis gas is cooled in the single connection tube to a temperature in the range from 600 to 1200°C and the slag droplets solidify;

the inlet temperature of the coolant being between 100 and 400°C and the outlet temperature being between 200 and 600°C.

6. An apparatus for carrying out the process as claimed in any one of the claims 1 to 5, comprising the following components:

a) a vertically positioned gasification reactor with a gas outlet at the top and the slag outlet at the bottom;

b) a waste heat boiler provided with a gas inlet near its top and a gas outlet near its bottom, and with cooling tubes;

c) connecting means connecting the gas outlet of the reactor with the gas inlet of the said waste heat boiler;

characterized in that

d) the whole waste heat boiler is located adjacent or next to the said reactor;

e) the gas inlet of the waste heat boiler is connected to the gas outlet of the reactor through a single connection tube, which connection tube has a smooth inner surface and runs at least for a major part in an upward direction;

f) an outer pipe surrounding at least a part of said single connection tube, said pipe being provided with an inlet and outlet for coolant and wherein the ratio between the inner diameter of the gasification reactor and the inner diameter of the said connection tube ranges from 2 to 15 and wherein the said tube has an inner diameter in the range of 0.1 to 2.0 metres."

Claims 1 and 6 of the first auxiliary request differ from Claims 1 and 6 of the main request in that it is specified that the single connection tube has a uniform diameter and that it is smooth enough to provide laminar flow along its length.

Claims 1 and 6 of the second auxiliary request differ from the corresponding claims of the main request in that it is specified the single connecting tube has a uniform diameter.

The Respondent requested that the appeal be dismissed.

VII. At the conclusion of the oral proceedings, the Board's decision to maintain the patent on the basis of the second auxiliary request was announced.

Reasons for the Decision

1. The appeal is admissible.

2. There are no objections under Article 123 EPC to the claims in accordance with the main request. Claim 1 of the request is based on granted Claim 1 in combination with column 1, lines 21 and 22, column 4, lines 42 to 44 and 55 to 58 and Figures 1 and 2 of the printed patent specification (cf. also original Claims 1 and 3 and page 4, lines 33 and 34 and page 5, lines 8 to 10 and Figures 1 and 2 of the published patent application).

Claim 6 of this request corresponds to Claim 6 as granted and column 1, lines 21 to 22, column 4, lines 31 to 37 and Figures 1 and 2 of the printed patent specification (cf. original Claim 7 and page 4, lines 26 to 28 and Figures 1 and 2 of the published patent specification).

Claims 2 to 5 and 7 to 9 of the main, first auxiliary and second auxiliary requests correspond to Claims 2 to 5 and 7 to 9 as granted (cf. Claims 2, 4, 5, 6 and 8 to 10 as filed).

2.1 In the Board's judgment, there is no basis in the application as filed for the feature that the inner walls of the single connection should be smooth enough to provide laminar flow along its length in Claims 1 and 6 of the first auxiliary request. Therefore, these claims are unallowable under Article 123(2) EPC.

To support his contention that there was a basis for the requirement that the flow in the connection tube is laminar in the original disclosure, the Appellant

submitted in the course of the oral proceedings the value for the average Reynold's number for the system in this tube calculated on the basis of the example of the disputed patent. The Appellant stated that this value, which any skilled chemical engineer could calculate, demonstrated the laminar flow of the gases in the connection tube. However, in the absence of any indication in the example of the inner and outer diameters of the tube, its length and the material from which it was made, the Board finds that the skilled person would not be in a position to make this calculation and could not, therefore, draw any conclusions regarding the nature of gas flow in the connection tube based on the original disclosure of the disputed patent.

2.2 Claims 1 and 6 of the second auxiliary request only differ from the respective claims of the main request in that it is specified that the connecting tube has a uniform diameter. This feature is supported by column 5, lines 10 and 11 of the printed patent specification (cf. also page 5, line 23 and 24 of the published patent application). Therefore, there are no objections under Article 123 EPC to this set of claims.

3. The patent in suit relates to a process and apparatus for the production of synthesis gas by combustion of finely divided carbonaceous fuel in which the molten slag droplets entrained in the synthesis gas are prevented from adhering to the walls and cooling tubes of heat exchanging equipment. Document (3a), which represents the closest state of the art, also discloses an apparatus for carrying out such a process.

3.1 In the light of this closest prior art, the technical problem underlying the disputed patent is to provide an alternative to this known process.

According to the disputed patent this technical problem is essentially solved by passing the synthesis gas from the gasification reactor at an average linear velocity ranging from 4 to 40 m/s through a single smooth-wall tube which connects the gasification reactor with a waste heat boiler. The crude synthesis gas is cooled in the tube to a temperature in the range 600 to 1200°C and the slag droplets solidified by passing a coolant, the inlet and outlet temperatures of which are between 100 and 400°C and 200 and 600°C respectively, in indirect heat exchange with the crude synthesis gas along at least part of the said connection tube.

3.2 According to the main request, the diameter of the connection tube may vary such that near the gas outlet of the gasification reactor it is greater than near the connecting means to the waste heat boiler (cf. column 5, lines 10 to 14). In Claims 1 and 6 of the second auxiliary request it is specified that the connection tube has uniform diameter.

3.3 It is plausible and not disputed that these proposed solutions solve the above-defined technical problems.

4. After examining the cited prior art, the Board has concluded that the subject-matter of the claims of both the main and second auxiliary request is novel. Since novelty is no longer in dispute, it is not necessary to give detailed reasons for this finding.

5. It is still necessary whether the claimed subject-matter involves an inventive step.

5.1 Main request

5.1.1 Document (3a) discloses that the technical problem underlying the disputed patent is solved by increasing the speeds of flow of the gas by suitably dimensioning the free cross-section of the gas passages in a part of a heat exchanger (radiant boiler) while keeping the volume of the synthesis gas unchanged. The effective gas rates of flow should be at least 9 m/s and gas speeds of 15 m/s are still more advantageous (cf. Claim 1 and page 3, lines 13 to 25).

According to Claim 4 this may be achieved by restricting the gas cross-section in a part of a single-tube radiant boiler to an annular channel by means of water-cooled pipe which projects from above to such an extent that the bottommost end is situated in a temperature zone of the single-tube radiant boiler where the entrained slag is no longer liquid or pasty. Alternatively, the radiant boiler attached to the gasification reactor may be constructed as a single-tube boiler attached to a multi-tube boiler with a restricted gas cross-section at its upper end (cf. Claim 5).

5.1.2 Therefore, from the teaching of document (3a), the skilled person would conclude that molten slag droplets entrained in synthesis gas may be prevented from adhering to the walls of heat exchanging equipment by ensuring that the diameter of a cooled tube which connects the gasification reactor to the waste heat boiler is greater near the gas outlet of the gasification reactor than near the end connected to the waste heat boiler (cf. also Figure 1).

Such a concept is covered by the claims of the main request as mentioned in paragraph 3.2 above.

5.1.3 The determination of a suitable temperature for the synthesis gas exiting the connection tube and appropriate inlet and outlet temperatures of the coolant in the indirect heat exchange with the synthesis gas in the connection tube is well within the competence of the skilled person.

5.1.4 Therefore, in the Board's judgment, the subject-matter of Claims 1 and 6 according to the main request does not involve an inventive step.

Since a request must be considered as a whole, dependent Claims 2 to 5 and 7 to 9 share the fate of the independent Claims 1 and 6. Therefore, the main request is rejected.

5.2 Second auxiliary request

5.2.1 Document (3a) teaches that in order to solve the technical problem underlying the disputed patent it is essential that the free cross-section of the gas passage in the tube connected directly to the gas outlet of the gasification reactor should be greater at the end of the tube near said outlet than at the end near the connecting means to the waste heat boiler.

Therefore, this document would not lead the skilled person in the direction of the present solution to this technical problem (i.e. uniform diameter).

5.2.2 In the introductory part of document (2a) it is stated that it is not possible to solve the technical problem underlying the disputed patent by placing a radiation boiler consisting essentially of a cylindrical double jacket between the gas outlet of a gasification reactor and a waste heat boiler and connecting this radiation

boiler to the waste heat boiler by means of a water-cooled tube through which the gas flows at a substantially uniform speed (cf. page 2, lines 16 to 42 and 52 to 65).

According to this document it is necessary to subject the gas on its transition from the radiation boiler to the waste heat boiler to a strong whirling motion and a single or repeated compression and expansion or change in flow velocity with simultaneous cooling in order to prevent the molten slag particles from adhering to the walls and tubes of the waste heat boiler (cf. page 2, lines 66 to 75).

Therefore, the teaching of this document teaches away from the present solution. Therefore, in the Board's judgment, the solution proposed in accordance with the second auxiliary request to the technical problem underlying the disputed patent is inventive in the light of the disclosure of document (2a) and (3a).

5.2.3 Therefore, the subject-matter of Claims 1 and 6 of this request involves an inventive step. Dependent Claims 2 to 5 and 7 to 9, which relate to preferred embodiments of the process of Claim 1 and the apparatus of Claim 6 respectively, are also allowable.

6. The Respondent's argument that, since the patent in suit teaches that tubes with uniform and varying diameters are equivalent to each other and the solution proposed according to main request was considered to be obvious, the proposed solution of the second auxiliary request must also be obvious cannot be entertained.

The knowledge concerning the equivalence of tubes with uniform and varying diameters was first imparted by the

disputed patent and, as shown above, the fact that the tubes are equivalent to one another is surprising in the light of the prior art.

The Board considers that if, as in this case, one of two or more embodiments of an invention is shown to be obvious the Patentee is fully entitled to restrict his claims to those embodiments not regarded as being obvious.

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 on the basis of auxiliary request No. 2 with consequential amendment to the description.

The Registrar: The Chairman:

E. Görgmaier K.J.A. Jahn