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Datasheet for the decision of 8 January 2020

Case Number: T 1880/16 - 3.3.05

Application Number: 08853299.9

Publication Number: 2227435

IPC: C01B3/02, C01B3/38, C01B3/48, C01C1/04

Language of the proceedings: EN

Title of invention:
PROCESS FOR PRODUCING AMMONIA SYNTHESIS GAS

Patent Proprietor:
CASALE SA

Opponent:
thyssenkrupp Industrial Solutions AG

Headword:
Ammonia synthesis gas/thyssenkrupp

Relevant legal provisions:
EPC Art. 56

Keyword:
Inventive step - (yes) - non-obvious alternative

Decisions cited:

Catchword:

Europäisches Patentamt
European Patent Office
Office européen des brevets

Beschwerdekammern

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Case Number: T 1880/16 - 3.3.05

D E C I S I O N
of Technical Board of Appeal 3.3.05
of 8 January 2020

Appellant 2: (Patent Proprietor)	CASALE SA Via Giulio Pocobelli 6 6900 Lugano (CH)
Representative:	Zardi, Marco M. Zardi & Co. SA Via Pioda 6 6900 Lugano (CH)
Appellant 1: (Opponent)	thyssenkrupp Industrial Solutions AG ThyssenKrupp Allee 1 45143 Essen (DE)
Representative:	Kutzenberger, Helga Kutzenberger Wolff & Partner Waidmarkt 11 50676 Köln (DE)
Decision under appeal:	**Interlocutory decision of the Opposition Division of the European Patent Office posted on 13 June 2016 concerning maintenance of the European Patent No. 2227435 in amended form.**

Composition of the Board:

Chairman	E. Bendl
Members:	S. Besselmann
	O. Loizou

Summary of Facts and Submissions

I. The appeals in this case, by the opponent (appellant 1) and the patent proprietor (appellant 2), lie from the interlocutory decision of the opposition division to maintain European patent No. 2227435 in amended form, based on the then pending auxiliary request V. The patent in suit concerns a process for producing ammonia synthesis gas.

II. In the decision under appeal the following documents are referred to, *inter alia*:

D1 DE 15 67 608 A1 (PULLMAN INC) 2 July 1970 (1970-07-02)

D3 GB 1 270 756 A (METALLGESELLSCHAFT AG [DE]) 12 April 1972 (1972-04-12)

III. The opponent (appellant 1) raised an objection of lack of inventive step in view of D1 in combination with D3. During the oral proceedings, it clarified that this was its only objection to the final main request.

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

"*1. Process for producing ammonia synthesis gas, the process comprising the steps of:*
- feeding a gas flow comprising hydrocarbons and a gas flow comprising steam to a primary reformer equipped with a plurality of externally heated catalytic tubes,
- reacting said hydrocarbons with said steam in the catalytic tubes of said primary reformer at an operating pressure of at least 45 bar in the catalytic tubes, obtaining a product gas,
- feeding said product gas and a flow of oxidant gas to a secondary reformer,

- subjecting said product gas to reaction with said oxidant gas and then to secondary reforming so as to reform all the hydrocarbons content of said product gas exiting the primary reformer and obtain a reformed gas comprising hydrogen, carbon oxides and unreacted steam,
- removing carbon oxides from said reformed gas, obtaining a synthesis gas suitable for synthesis of ammonia,
characterized in that *said oxidant gas is oxygen-enriched air having an appropriate N_2/O_2 molar ratio to obtain a reformed gas having a content of nitrogen corresponding to the content required for the stoichiometric H_2/N_2 molar ratio for ammonia synthesis, said oxygen-enriched air having a O_2 content from 22 to 50 in mol% and being supplied to the secondary reformer in a ratio of 0.35 to 0.5 mol of oxygen content of the enriched air stream per mol of carbon in hydrocarbons entering the primary reformer or a pre-reformer if used.*"

Claims 2-5 relate to preferred embodiments.

V. The patent proprietor's arguments, where relevant to the present decision, may be summarised as follows:

Document D1 constitutes the closest prior art.

The subject-matter of claim 1 differs from D1 in the oxygen content of the oxidant gas and the molar amount of oxygen supplied per mole carbon.

The technical problem solved is the provision of an improved process, as set out in the patent in suit (paragraph [0016]), avoiding the need for heat exchangers.

D1 does not itself prompt the skilled person to use the claimed ranges of oxygen content of the oxidant gas and the molar amount of oxygen supplied per mole carbon. The skilled person would not consult D3 because it discloses liquid nitrogen scrubbing with the purpose of feeding nitrogen downstream of a secondary reformer.

The skilled person would therefore not have arrived at the proposed solution, namely the claimed process, in an obvious manner.

VI. The opponent's arguments, where relevant to the present decision, may be summarised as follows:

Document D1 constitutes the closest prior art.

The subject-matter of claim 1 differs from this known process in that the oxygen-enriched air is supplied to the secondary reformer in a ratio of 0.35 mol to 0.5 mol of oxygen content per mole of carbon in the hydrocarbons entering the primary reformer (or pre-reformer if used).

There is no further difference, the oxygen content of 22 to 50 mol% O_2 being anticipated by the mention of "oxygen-enriched air" in D1.

The claimed process does not provide any technical effect over D1, and in particular does not avoid the need for heat exchangers between the primary and secondary reformers because these are not excluded from the claim.

The objective technical problem is therefore merely the provision of an alternative.

The skilled person faced with the technical problem of providing an alternative would turn to D3 because D3 relates to the same technical field. It is irrelevant that the process known from D3 involves nitrogen scrubbing because neither D1 nor the claim excludes nitrogen scrubbing. The skilled person would apply the teaching of D3 regarding a suitable oxygen-to-carbon ratio to the process of D1 and hence arrive at the claimed process in an obvious manner.

In addition, D1 itself already prompts the skilled person to increase the O_2 content to cope with the increased hydrocarbon content in the secondary reformer.

Moreover, the ranges relating to the O_2 content and the molar ratio of oxygen to carbon are obvious because they derive from the mass balance of the process.

The claimed process therefore lacks an inventive step.

VII. Appellant 2 (patent proprietor) requested that the decision under appeal be set aside and that the patent be maintained in amended form on the basis of the main request (filed with the statement of grounds of appeal as the second auxiliary request), or, alternatively, on the basis of the third or fourth auxiliary requests, also filed with the statement of grounds of appeal. It furthermore requested that the appeal of the opponent be dismissed (fifth auxiliary request).

Appellant 1 (opponent) requested that the decision under appeal be set aside and the patent be revoked.

Reasons for the Decision

Main request

1. Claim 1 of the main request corresponds to a combination of claims 1 and 2 of the patent as granted.

2. Inventive step

2.1 The patent in suit concerns a process for producing ammonia synthesis gas comprising hydrogen (H_2) and nitrogen (N_2) (paragraphs [0001], [0002]).

2.2 D1 also relates to a process for producing a hydrogen-containing gas, in particular for ammonia synthesis (page 1, first paragraph), and thus to the same purpose as the patent in suit. It is common ground between the parties that D1 constitutes the closest prior art. The board has no reason to take a different view.

2.3 The relevant disclosure of D1 is a process in which the amount of nitrogen fed to the secondary reformer is such that the synthesis gas has a molar ratio of H_2 to N_2 of about 3:1 (page 12, lines 8-12).

Hence, the nitrogen content required for the stoichiometric H_2/N_2 molar ratio of the ammonia synthesis gas is added in the secondary reforming step, as is the case in the claimed process.

2.4 The opponent acknowledges that the subject-matter of claim 1 differs from D1 in that oxygen-enriched air is supplied to the secondary reformer in a molar ratio of 0.35 mol to 0.5 mol of oxygen content per mole of carbon in the hydrocarbons entering the primary

reformer (or pre-reformer if used), but views this as the only distinguishing feature.

2.5 The board agrees that this molar ratio is a distinguishing feature, given too that D1 discloses an amount of 0.05 to 0.15 mol of oxygen per mole of dry gas in the hydrocarbon-containing feed (page 12, lines 3-8).

2.6 The patent proprietor asserts that there is an additional difference: that the oxidant gas, namely the oxygen-enriched air, has an oxygen content of from 22 to 50 mol% O_2. The opponent, by contrast, believes that this range is anticipated by the general reference to "oxygen-enriched air" in D1, because air has an oxygen content of about 21 mol% and pure oxygen has an oxygen content of 100 mol%.

2.7 The board finds that the general reference to "air or oxygen-enriched air" in D1 (page 12, lines 12-22) does not constitute a direct disclosure of a specific range of oxygen content. It therefore concludes that this general reference in D1 does not anticipate the claimed range of 22 to 50 mol% O_2.

2.8 Hence, the features relating to
i) the oxygen content of the oxygen-enriched air and
ii) the supply ratio of 0.35 mol to 0.5 mol of oxygen content per mole of carbon,
which are the features of claim 2 as granted, distinguish the process of claim 1 from D1.

2.9 These are the same distinguishing features that were considered by the opposition division in its decision regarding the then pending auxiliary request V.

2.10 The patent proprietor holds that the claimed process avoids the need for heat exchangers between the primary and secondary reformers. In its opinion, the technical problem may accordingly be formulated, based on paragraph [0016] of the patent in suit, as providing an improved process which is easy to implement and makes it possible to obtain high production capabilities with low operating and investment costs and low energy consumption.

2.11 The opponent contests that the indicated improvement is obtained. In its opinion, the objective technical problem is merely the provision of an alternative.

2.12 Even if the objective technical problem is merely the provision of an alternative process, the subject-matter of claim 1 involves an inventive step, for the reasons correctly set out by the opposition division in its decision.

2.13 There is no doubt that this less ambitious technical problem is solved by the process of claim 1, using as the oxidant gas oxygen-enriched air having an O_2 content from 22 to 50 mol%, and supplying it to the secondary reformer in a ratio of 0.35 mol to 0.5 mol of oxygen content per mole of carbon in the hydrocarbons entering the primary reformer (or pre-reformer if used).

2.14 According to the opponent, the skilled person would have been prompted by the teaching of D3 to modify the known process of D1 accordingly.

2.15 However, while D3 relates to the same technical field of producing ammonia synthesis gas, it relates to a different process configuration, in which only a

portion of the nitrogen is added to the secondary reformer, and, as an essential feature, a final step of scrubbing with liquid nitrogen is carried out to introduce the required nitrogen content into the gas (page 2, lines 25-55).

2.16 In contrast to the opponent's view, neither the claimed process nor the relevant process of D1 is compatible with a final scrubbing step to introduce nitrogen, because the necessary nitrogen content has already been introduced into the secondary reformer. The skilled person would therefore not have had any reason to turn to D3 to identify a suitable oxygen-to-carbon molar ratio for modifying the process known from D1.

2.17 Moreover, the oxygen-enriched air stream of D3 (termed "nitrogen-containing oxygen fraction" in D3, see page 2, line 56f.) has an oxygen content for instance of 85 vol.-% (see the example of D3) and thus far above the claimed range of up to 50 mol%.

2.18 In a given process, the ratio of oxygen provided per carbon atom in the initial feed stream is linked with the oxygen content of the oxygen-enriched air and with the requirement to obtain a reformed gas having a content of nitrogen corresponding to the stoichiometric H_2/N_2 molar ratio for ammonia synthesis.

2.19 The skilled person, even if faced with the technical problem of providing an alternative, would have had no reason to employ the oxygen-to-carbon molar ratio of D3 in the process of D1 and then to make a further modification by selecting an O_2 content of from 22 to 50 mol%.

2.20 Nor does the board agree with the opponent's additional argument that D1 itself already prompts the skilled person to increase the oxygen content to cope with increased hydrocarbon content in the secondary reformer. Rather, the essence of the teaching of D1 is the use of heat exchangers between the primary and secondary reformers.

2.21 Nor has the opponent provided any evidence in support of its allegation that the claimed ranges were so broad that the mass balance of the process would dictate both the claimed supply ratio of oxidant gas in terms of moles of oxygen content per mole of carbon and also the claimed oxygen content of the oxygen-enriched air.

2.22 Starting from D1 as the closest prior art, the skilled person would therefore not have arrived at the claimed process in an obvious manner.

2.23 The subject-matter of claim 1 consequently involves an inventive step (Article 56 EPC).

2.24 Claims 2-5 depend on claim 1, so they involve an inventive step for the same reasons.

Auxiliary requests

3. In view of the conclusion reached in respect of the main request, there is no need to address the auxiliary requests.

Order

For these reasons it is decided that:

1. The decision under appeal is set aside.

2. The case is remitted to the department of first instance with the order to maintain the patent in amended form on the basis of the claims of the main request filed with the statement of grounds of appeal as the second auxiliary request and a description to be adapted if necessary.

The Registrar: The Chairman:

C. Vodz E. Bendl

Decision electronically authenticated