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Bezeichnung der Erfindung: Process for the preparation of methanol
Title of invention:
Titre de l'invention :

Klassifikation / Classification / Classement : C07C 31/04

ENTSCHEIDUNG / DECISION

vom / of / du 9 August 1990

Anmelder / Applicant / Demandeur :

Patentinhaber / Proprietor of the patent /
Titulaire du brevet : Stamicarbon B.V.

Einsprechender / Opponent / Opposant : Metallgesellschaft AG

Stichwort / Headword / Référence : Stamicarbon/METHANOL

EPÜ / EPC / CBE Article 56

Schlagwort / Keyword / Mot clé : "Inventive step (denied)"

Leitsatz / Headnote / Sommaire

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Case Number : T 438/89 - 3.3.1

DECISION
of the Technical Board of Appeal 3.3.1
of 9 August 1990

Appellant : (Proprietor of the patent)
Stamicarbon B.V.
Mijnweg 1
NL-6167 AC Geleen (NL)

Representative :

Respondent : (Opponent)
Metallgesellschaft AG
Reuterweg 14
Postfach 10 15 01
D-6000 Frankfurt am Main 1

Representative :

Decision under appeal : **Decision of Opposition Division of the European Patent Office dated** 30 January 1989, posted on 23 March 1989 **revoking European patent** No. 0 007 491 **pursuant to Article 102(1) EPC.**

Composition of the Board :

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

Summary of Facts and Submissions

I. The grant of European patent No. 0 067 491 in respect of European patent application No. 82 200 719.1 was published on 11 March 1987 (cf. Bulletin 87/11).

II. A notice of opposition, filed on 17 September 1987, requested the revocation of the patent on the ground that its subject-matter did not involve an inventive step. The opposition was supported **inter alia** by the following document:

(3) DE-B-2 024 301.

III. By a decision delivered orally on 30 January 1989, with written reasons posted on 23 March 1989, the Opposition Division revoked the patent. The Opposition Division held that the proposed solution to the technical problem of providing a further process for the manufacture of methanol from synthesis gas in accordance with the reaction parameters disclosed in document (3), whereby the limitation of this prior art process with respect to the starting material for the synthesis gas manufacture is overcome, was obvious in view of the cited prior art. In the Opposition Division's opinion, even if the claimed process has a low overall energy consumption, in the particular circumstances this beneficial effect cannot support an inventive step.

IV. An appeal was lodged against this decision on 31 May 1989 with payment of the prescribed fee. In his statement of grounds filed on 1 August 1989, his letter filed on 2 August 1990 and during the oral proceedings held on 9 August 1990, the Appellant contended that the technical problem underlying the disputed patent was to provide a process for the manufacture of methanol which consumes less energy than the prior art process without requiring excessive capital investment. According to the Appellant synthesis gas for use in the manufacture of methanol is conventionally produced by the catalytic steam reforming of natural gas or naphtha or by the non-catalytic oxidation of high boiling hydrocarbon. In the light of this prior art, which points away from the invention, there would be no incentive to combine the catalytic partial oxidation of C_{1-3} hydrocarbons with a methanol synthesis to solve the present problem since the skilled person would be convinced that the necessity of using pure oxygen would lead to the consumption of more energy.

Although the various stages of the present process may have been separately described in the prior art, it is only with the benefit of hindsight that these known stages are combined to arrive at the advantageous process of the disputed patent.

With regard to the documents submitted by the Respondent with his response to the grounds of appeal, the Appellant considered that they did not clearly disclose partial oxidation of lower hydrocarbons, in combination with methanol synthesis. Thus, Dechema-Monographien, Nr. 477-502, pages 47 to 56, 1959 (document (18)) merely reviews possible synthesis gas production processes and refers to the disadvantage that oxygen must be used in place of air for the synthesis of methanol. The other document, Nitrogen, May 1962, pages 35 to 38 (document (19)), refers to the production of ammonia and implies that the process disclosed therein would be less useful for the preparation of methanol. Moreover, the Appellant claimed that recycling of carbon dioxide as disclosed in this document would be detrimental to the present process.

V. The Respondent has argued that the individual stages of the claimed process are known, and that in combining these known stages it was not necessary to overcome any difficulties or technical prejudices. The conversion of lower hydrocarbons to raw synthesis gas by catalytic partial oxidation and the use of this gas in which the stoichiometric number has been adjusted to the desired value for the manufacture of methanol is disclosed in documents (18) and (19).

The Respondent maintained that it was well within the competence of a skilled person to combine the stages known from different documents with a view to arrive at a cost effective process.

VI. The Appellant requested that the decision under appeal be set aside and a patent maintained on the basis of Claim 1 as filed on 30 January 1988 and granted Claims 2 to 7. The above-mentioned Claim 1 reads as follows:

"Process for the preparation of methanol by converting a hydrocarbon by partial oxidation into a gas mixture containing CO and H_2 supplying this gas mixture to a reactor in which, at a temperature of between 240°C and 320°C and at a pressure of between 40 and 100 bar in the presence of a suitable catalyst, it is converted into methanol, and the methanol, after cooling and expansion to approximately atmospheric pressure, is separated off and sent to a purification section, the energy released in the partial oxidation and in the methanol synthesis being applied for the generation of steam in an amount sufficient to meet the energy requirements of an oxygen plant supplying the oxygen required for the partial oxidation, this process being characterized in that as hydrocarbon a C_{1-3} hydrocarbon or hydrocarbon mixture is converted with O_2 and H_2O by partial oxidation in the presence of a suitable catalyst at a temperature of between 800 and 1200°C and a pressure of between 20 and 100 bar into a gas mixture substantially consisting of CO, CO_2 and H_2, and such an amount of CO_2 is removed from this gas mixture by adsorption in a suitable medium that the $H_2/2\ CO + 3\ CO_2$ molar ratio is between 0.95 and 1.05, and this gas mixture is supplied to the reactor."

The Respondent requested that the appeal be dismissed.

VII. At the conclusion of the oral proceedings, the Board's decision to dismiss the appeal was announced.

Reasons for the Decision

1. The appeal complies with Articles 106 to 108 and Rule 64 EPC and is, therefore, admissible.

2. There are no formal objections under Article 123 EPC to the present Claim 1 since it corresponds to Claim 1 as filed and granted drafted in the two-part form in the light of the disclosure in document (3).

3. The Respondent cited documents (18) and (19) for the first time in his response to the grounds of appeal. In view of the fact they are highly relevant, the Board has decided to admit them into the proceedings.

4. The disputed patent relates to a low-to-medium pressure process for the production of methanol from synthesis gas obtained by the partial oxidation of a hydrocarbon feedstock with oxygen and steam. The energy released from the methanol synthesis and partial oxidation is used to generate steam which is used to produce the energy for the

plant supplying the oxygen required for the partial oxidation.

4.1 Document (3), which is considered to represent the closest prior art, discloses a low-to-medium pressure process for the manufacture of methanol wherein high boiling hydrocarbons are partially oxidised and the resulting raw synthesis gas purified in one or more steps before being converted to methanol (cf. Claim 1). The high pressure steam produced by the heat of formation of the methanol can be expanded to atmospheric pressure to provide the energy for the compression of air for the production of pure oxygen (cf. column 3, lines 47 to 52). The high pressure steam available for the waste heat boiler associated with the crude synthesis gas producer may be partially expanded in a back-pressure turbine to provide energy to compress the pure oxygen and recycled synthesis gas and the remaining low pressure steam used to heat the methanol distillation column and the regeneration plant associated with a scrubber for removing carbon dioxide (cf. column 3, lines 52 to 63).

4.2 In the light of this closest prior art, the technical problem underlying the patent in suit may be seen in providing an alternative low-to-medium pressure process for the manufacture of methanol from synthesis gas.

This technical problem is essentially and successfully solved by producing a raw synthesis gas by the catalytic partial oxidation of a C_{1-3} hydrocarbon or hydrocarbon mixture and partially removing some of the carbon dioxide present in the raw gas by adsorption in a suitable medium to give a synthesis gas having an $H_2/2CO + 3CO_2$ mole ratio of between 0.95 and 1.05.

4.3 During the oral proceedings the Respondent admitted that, in certain circumstances, the claimed process might be economically advantageous. However, this economic advantage in itself cannot define the technical problem, since whether in fact an economic advantage accrues could be the outcome of factors of a non-technical nature, such as, for example, availability of natural gas, site and size of the plant and cost of raw materials.

5. After examination of the cited prior art, the Board has reached the conclusion that the claimed subject-matter is novel. Since novelty is not disputed, it is not necessary to consider this matter in detail.

6. It still remains to be examined whether the requirement of inventive step is met by the subject-matter of the patent in suit.

6.1 According to the Appellant, before the priority date of the disputed patent it was common general knowledge that the synthesis gas used for the manufacture of methanol was obtained either by the non-catalytic partial oxidation of high boiling hydrocarbons or by the steam reforming of lower hydrocarbons. However, if the intended use of the synthesis gas was for the manufacture of ammonia, it was also feasible to produce it by the catalytic partial oxidation of lower hydrocarbons because, as the gas fed to the ammonia reactor had to contain nitrogen, it was possible to employ air in the oxidation reaction, thus avoiding the disadvantages associated with the use of pure oxygen.

6.2 This view of the situation prevailing before the claimed priority date is, however, not supported by the disclosure of documents (18) and (19).

Document (18) discloses both the non-catalytic and catalytic partial oxidation in the presence of oxygen and steam under pressure of methane-containing gas such as natural gas (cf. Table 1 on page 51). In the paragraph bridging pages 51 and 52 the question of whether to carry out this oxidation with air or oxygen is considered and it is indicated that, if the synthesis gas is to be used for methanol synthesis or Fischer Tropsch synthesis, nitrogen is an inert gas and its presence is, therefore, undesirable. Although oxygen-enriched air can be used for the oxidation if the resulting gas is intended for the synthesis of ammonia, nevertheless the author considers that, in general, it is necessary to use oxygen and since this increases the costs, the catalytic process is more advantageous than the non-catalytic one (cf. first complete paragraph on page 52). Therefore, this document clearly teaches that crude synthesis gas for the manufacture of methanol may be produced by the partial catalytic oxidation of lower hydrocarbons in the presence of oxygen and steam.

Document (19) discloses the catalytic partial oxidation of light hydrocarbon fractions such as methane, refinery off-gasses, LPG and light naphtha at pressures in excess of 16 bar using air, oxygen-enriched air or pure oxygen, depending upon feedstock, process requirements and other circumstances (cf. paragraph headed "Feedstock Flexibility" on page 37). The use of natural gas is linked with the availability of low cost oxygen (cf. lines 5 and 6 of the paragraph headed "Advantages" on page 37). Table III on page 38 of this document discloses the catalytic partial oxidation of natural gas with 98.5% oxygen and the use of the resulting synthesis gas for the manufacture of methanol. To avoid a carbon monoxide shift operation and to obtain a synthesis gas having hydrogen, carbon monoxide and carbon dioxide in the appropriate amounts for the synthesis of methanol, i.e. the correct stoichiometric number, the partial catalytic oxidation is usually carried out with recycle carbon dioxide, steam and oxygen (cf. paragraph beginning "Typical yield" in the right-hand column on page 37).

During the oral proceedings, the Appellant admitted that it was normal to adjust the stoichiometric number of the crude synthesis gas to the correct value for the manufacture of methanol. In the Board's judgment, the fact that one method for making this adjustment is described in this document would not deter the skilled person from considering other known methods, such as removal of an appropriate amount of carbon dioxide by adsorption in a suitable medium. Thus, DE-B-1 262 987 (document (2)), discloses that carbon dioxide content of a methanol synthesis gas can be adjusted to give the correct stoichiometric number by washing a part of the raw synthesis gas with crude methanol (cf. Claim 1).

Therefore, document (19) also refutes the Appellant's allegation that it was not previously known to combine partial catalytic oxidation of lower hydrocarbons with a methanol synthesis.

6.3 Thus, in the light of the disclosure of documents (18) and (19), the skilled person seeking an alternative to the process disclosed in document (3) for the manufacture of methanol would readily envisage the replacement of the non-catalytic partial oxidation of higher hydrocarbons by the known catalytic partial oxidation of C_{1-3} hydrocarbons. Moreover, it would be well within the competence of the skilled person to compare the costs and energy requirements of the two processes and to conclude that, under certain circumstances, the present process is an economically viable alternative to the process disclosed in document (3).

6.4 In the Board's judgment, the proposed solution to the technical problem underlying the disputed patent is obvious. Therefore the subject-matter of Claim 1 does not involve an inventive step.

6.5 Dependent Claims 2 to 7, which relate to preferred embodiments of the process in accordance with Claim 1, do not contain any independent features and are, therefore, unallowable in the absence of an allowable main claim.

Order

For these reasons, it is decided that:

The appeal is dismissed.

The Registrar: The Chairman:

M. Beer K.J.A. Jahn