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File Number: T 591/91 - 3.3.1
Application No.: 83 302 291.6
Publication No.: 0 093 552
Title of invention: Hydrocracking process

Classification: C10G 65/12

D E C I S I O N
of 28 January 1993

Applicant: Mobil Oil Corporation

Headword: Hydrocracking/MOBIL

EPC Article 56

Keyword: "Inventive step (confirmed) - after amendment"



Case Number : T 591/91 - 3.3.1

D E C I S I O N
of the Technical Board of Appeal 3.3.1
of 28 January 1993

Appellant : Mobil Oil Corporation
150 East 42nd Street
New York
New York 10017 (US)

Representative : Colmer, Stephen G.
Mobil Court
3 Clements Inn
London WC2A 2EB (GB)

Decision under appeal : Decision of the Examining Division of the
European Patent Office dated 12 March 1991
refusing European patent application
No. 83 302 291.6 pursuant to Article 97(1) EPC.

Composition of the Board :

Chairman : K.J.A. Jahn
Members : R.W. Andrews
J-C. Saisset

Summary of Facts and Submissions

- I. European patent application No. 83 302 291.6 (publication No. 0 093 552) was filed on 22 April 1983.

- II. By a decision dated 12 March 1991, the Examining Division refused the application on the ground that the subject-matter of Claims 1 to 12 filed on 2 October 1989 did not involve an inventive step in the light of the disclosure of

(1) US-A-3 159 568.

In the Examining Division's opinion, the only difference between the process of document (1) and the present one lay in the omission of a liquid recycling step. However, this step could also be omitted in the prior art and its omission, which did not produce a surprising effect, would be decided by market forces. Furthermore, a product with a high aromatic content was to be expected under the mild cracking conditions of the present application.

- III. An appeal was lodged against this decision on 13 May 1991 with payment of the prescribed fee. In his statement of grounds of appeal filed on 19 July 1991 and during the oral proceedings held on 28 January 1993, the Appellant contended that document (1) is solely concerned with gasoline production. This is achieved by hydrocracking different feedstocks from those used in the present process at higher pressures and recycling the higher boiling effluent from the hydrocracker(s), resulting in a high volume conversion to gasoline, even if the volume conversion per pass may be lower than 50%. The Appellant also argued that document (1), read without the benefit of hindsight or in the manner in which it would have been

read by the skilled person, does not disclose a hydrocracking process without liquid recycle.

The Appellant also maintained that document (1) provided no indication or motivation to alter the process disclosed therein for the production of gasoline in the manner suggested with the expectation of solving the problem of improving distillate selectivity.

- IV. The Appellant requested that the decision under appeal be set aside and a patent be granted on the basis of Claims 1 to 12, pages 1 to 24 and Figures 1 to 3 as submitted during the oral proceedings. The only independent claim of the set of claims reads as follows:

"A hydrocracking process of improved distillate selectivity which comprises:

- (i) passing a hydrocarbon feedstock comprising a heavy gas oil having an initial boiling point of at least 294°C containing nitrogenous and sulfurous impurities over a hydrotreating catalyst in the presence of hydrogen at an elevated temperature and pressure of not more than 7000 kPa to hydrotreat the feedstock; and
- (ii) passing the hydrotreated feedstock without intermediate separation or liquid recycle over a hydrocracking catalyst in the presence of hydrogen at an elevated temperature and pressure of not more than 7000 kPa to hydrocrack the feedstock at a volume conversion to distillate boiling range products of less than 50 percent."

- V. At the conclusion of the oral proceedings, the Board's decision to order the grant of the patent on the basis of the documents filed during the oral proceedings was announced.

Reasons for the Decision

1. The appeal is admissible.
2. There are no objections under Article 123(2) to the present claims and description. Claim 1 is based on Claims 1 and 2 as filed in combination with page 3, lines 15 to 19 and original Example 5. Claims 2 to 12 correspond to originally filed Claims 3 to 13. The description has been amended to bring it into agreement with amended Claim 1 and to acknowledge document (1). The 343°C⁺ conversion on page 22 has been converted from wt. percent to vol. percent since this is the basis referred to in Claim 1. Figures 1 to 3 are identical to Figures 1 to 3 as originally filed.
3. The application relates to a low pressure hydrocracking process comprising hydrofining a hydrocarbon feedstock containing nitrogenous and sulphurous impurities and passing the hydrotreated product without intermediate separation or liquid recycle over a hydrocracking catalyst.

Document (1), which represents the closest prior art, discloses a process for the production of low-boiling hydrocarbons in which a mineral oil feedstock containing organic nitrogen and/or sulphur compounds is hydrofined and the resulting effluent, without intervening purification to remove the decomposition products of said impurities, is passed into a hydrocracking zone. The pressure in the hydrofining and hydrocracking zones is less than about 13890 kPa (2000 psig) (cf. Claim 1). The aim of this prior art process was to improve the conversion to gasoline (cf. column 2, lines 55 and 56).

In the light of this closest state of the art the technical problem underlying the application in suit is to provide a hydrocracking process in which a high yield of a distillate boiling range product is achieved. Distillate boiling range products include, for example, jet fuels, kerosine and heating oils (cf. last two lines of page 2). In the present context, a high yield of distillate boiling range product is considered to be equivalent to achieving high selectivity to the desired product. According to the application, the technical problem is essentially solved by subjecting a heavy gas oil having an initial boiling point of at least 294°C containing nitrogenous and sulphurous impurities to hydrofining at a pressure of not more than 7000 kPa and passing the hydrotreated product without intermediate separation or liquid recycle over a hydrocracking catalyst at a pressure of not more than 7000 kPa to hydrocrack the feedstock at a volume conversion to distillate boiling range product of less than 50%.

In the light of original Example 5, the Board is satisfied that this technical problem has been solved.

4. After examination of the cited prior art, the Board has reached the conclusion that the claimed subject-matter is novel. Since in the decision under appeal the Examining Division also considered the claimed subject-matter novel, it is not necessary to give detailed reasons for this finding.
5. It still remains to be decided whether the subject-matter of the present claims involves an inventive step.
- 5.1 As previously mentioned, document (1) describes a hydrocracking process the main object of which is to improve the conversion to gasoline (cf. column 2, lines 55 and 56.

Although in column 1, lines 31 to 35 of this document it is stated that the unconverted residue from the first (or only) hydrocracker may be reheated and recycled to the same hydrocracker, or preferably passed through a second bed of hydrocracking catalyst (cf. also column 3, lines 58 to 60), the skilled person would, from his reading of the document as a whole, conclude that the higher boiling products are hydrocracked to extinction in this known process.

Therefore, the skilled person would consider that, in order to achieve high conversion to gasoline, liquid recycle is an essential feature of this prior art process and would not consider that it could be omitted.

The skilled person's conclusion in this respect is borne out by the disclosure of document (1) concerning percent conversions, which are quoted as being those per pass (cf. column 1, lines 35 to 36 and column 6, lines 51 to 52). Moreover, according to Example I the volume of gasoline recovered was 104% of the volume of fresh feed which was converted to all products boiling below 204°C (400°F).

On the other hand, Example II discloses the hydrocracking of a feedstock having an end boiling point of 315°C (600°F) by passing it first through a bed of hydrofining catalyst and then directly through a hydrocracking catalyst. The hydrocracking temperature was adjusted to give a 38% conversion to 204°C (400°F) end-point gasoline; i.e. this conversion is on a one-through basis. However, since this Example was specifically to demonstrate the benefit obtained by employing an integral pre-hydrofining step ahead of the first hydrocracking zone, the skilled person would not change his opinion that liquid recycle is an essential feature of this prior art process.

According to document (1), the process disclosed therein may be operated at pressures less than about 13890 kPa (2000 psig. cf. Claim 1). In view of these low pressures it was found that in order to avoid rapid deactivation of the catalyst, it was necessary to limit the conversion per pass to gasoline (cf. column 6, lines 46 to 50). Therefore, this document teaches there is a relationship between the pressure at which the hydrocracking process is operated, the conversion to gasoline and catalyst deactivation.

In the Board's judgment, this teaching, which is tailored to a process having improved conversion to gasoline, would not hold out any prospect of how the different problem of improved distillate boiling range product yield or selectivity could be solved. The mere fact that there is a superficial similarity in the conditions and sequence of the process steps of this known process and the present one does not justify the conclusion that it was obvious to adopt this prior art process to the new desideratum. In the absence of further evidence, the Board sees no reason why the skilled person would expect that, if he were to use a feedstock having an initial boiling point of at least 294°C rather than one having an end boiling point of 538°C (1000°F); cf. column 10, lines 30 to 41), operate the hydrofining and hydrocracking stages at pressures of less than 7000 kPa without intermediate separation between the hydrofining and hydrocracking stages or liquid recycle at a volume conversion of less than 50%, he would achieve products of the desired distillate boiling range in high yields. This is borne out by a comparison of original Examples 1 to 4 (now comparative examples) with original Example 5. These comparative examples clearly demonstrate

that the selection of feedstocks, pressures and volume conversions falling outside the ambit of present Claim 1 leads to a decrease in selectivity (yield) of distillate boiling range products.

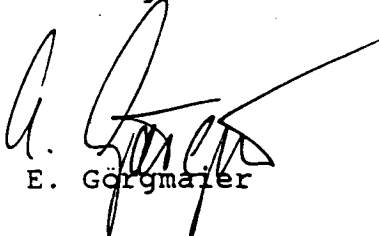
Therefore, in the Board's judgment, the proposed solution to the technical problem of providing a hydrocracking process in which high yields of a distillate boiling range products are achieved is inventive. Thus, Claim 1 and Claims 2 to 12, which relate to preferred embodiments of the process according to Claim 1, are allowable.

Order

For these reasons, it is decided that:

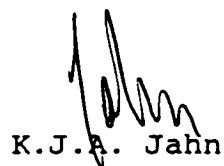
1. The decision under appeal is set aside.
2. The case is remitted to the first instance with the order to grant a patent on the basis of Claims 1 to 12, pages 1 to 24 of the description and figures 1 to 3 as submitted during oral proceedings.

The Registrar:



E. Görgmaier

The Chairman:



K.J.A. Jahn