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Publication Number: 1404783
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Title of invention: Process for the production of paraffinic middle distillates
Opponent: Sasol Technology (Pty) Ltd
Headword: Process for middle distillates/ENI
Relevant legal provisions:
Relevant legal provisions (EPC 1973): EPC Art. 56
Keyword: "Inventive step: yes"
Decisions cited:
Catchword:
Case Number: T 1922/08 - 3.3.06

DECISION
of the Technical Board of Appeal 3.3.06
of 11 March 2011

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Composition of the Board:
Chairman: P.-P. Bracke
Members: P. Ammendola
U. Tronser
Summary of Facts and Submissions

I. This appeal is from the interlocutory decision of the Opposition Division concerning the maintenance in amended form of European patent No. 1 404 783 according to the then pending auxiliary request of the Patent Proprietors.

II. Claim 1 of the patent as granted reads as follows:

"1. A process for the preparation of middle distillates substantially without oxygenated organic compounds, starting from a synthetic mixture of partially oxygenated, substantially linear hydrocarbons, containing at least 20% by weight of a fraction having a distillation temperature higher than 370°C; said process comprising the following steps:

i) separating said mixture into at least one low-boiling fraction (B) richer in oxygenated compounds, and at least one high-boiling fraction (A) less rich in oxygenated compounds;

ii) subjecting said fraction (B) to a hydrogenating treatment under such conditions as to avoid any substantial variation in its average molecular weight, to obtain a hydrogenated mixture of substantially non-oxygenated hydrocarbons;

iii) recombining at least a part of said hydrogenated mixture according to step ii) with said fraction (A), to form a mixture (C) of linear hydrocarbons with a reduced content of oxygenated hydrocarbons and
subjecting said mixture (C) to a hydrocracking treatment in the presence of a suitable catalyst, so as to convert at least 40% of said high-boiling fraction into a fraction of hydrocarbons which can be distilled at a temperature lower than 370°C;

iv) separating at least one fraction of hydrocarbons, from the product obtained in step (iii), whose distillation temperature is within the range of middle distillates."

The remaining granted claims 2 to 36 define preferred embodiments of the process of claim 1.

III. The Opponent had sought revocation of the granted patent for lack of novelty and of inventive step. During the opposition proceedings it had made reference, inter alia, to the documents

(2) = EP-A-1 101 813

and


IV. The Opposition Division found that the subject-matter of claim 1 as granted (hereinafter claim 1) was not anticipated in the prior art but lacked of an inventive step.

The Opposition Division noted, inter alia, that not only document (2) but also document (3) addressed the same problem considered in the patent-in-suit, i.e. that of rendering available a process for upgrading
synthetic mixtures of substantially linear hydrocarbons obtainable from the Fischer-Tropsch synthesis (hereinafter F-T mixtures) to give a high yield of middle distillates with good cold-flow properties. The process of document (2) was however found to be closer to the patented subject-matter than the process of document (3).

According to the decision under appeal, a skilled person, seeking to have as much hydrocarbons as possible in the final product, would be aware that a separated low-boiling fraction inevitably resulted from any normal F-T synthetic process and would note that paragraph [0049] of document (2) disclosed two options for removing the undesired oxygenated compounds possibly present in the F-T mixture to be upgraded, i.e. either the option of preliminarily separating therefrom a low-boiling fraction containing most of the oxygenated compounds (hereinafter also indicated as the first option) or the option of subjecting the whole F-T mixture to selective hydrotreatment priory to hydrocracking (hereinafter also indicated as the second option). Since document (2) contained no explicit disclosure of any subsequent use of the low-boiling fraction removed according to the first option, the skilled person would derive from the second option in the same citation an implicit suggestion to hydrotreat also this low-boiling fraction, and then to recombine the resulting hydrotreated low-boiling fraction with the high-boiling one at some subsequent stage (i.e. either before or after the hydrocracking / hydroisomerization step).
Therefore, the question of whether the subject-matter of claim 1 was inventive turned on whether the skilled person on the basis of the teaching of document (2) would recombine the hydrotreated low-boiling fraction with the high-boiling fraction prior to hydrocracking / hydroisomerization.

In the finding of the Opposition Division, the skilled person would consider the disclosure in paragraphs [0018] to [0021] of document (2) that a specific catalyst allowed to hydrocrack / hydroisomerize in a single step the entire C7+ fraction of the F-T mixture (i.e. low- and high-boiling linear hydrocarbons) as a clear incentive to recombine the hydrotreated low-boiling fraction with the high-boiling fraction before the hydrocrack / hydroisomerization step, thereby arriving at the patented subject-matter without exercising any inventive ingenuity.

The Opposition Division also found that the amended form of the European patent according to the then pending auxiliary request of the Patent Proprietors complied with the requirements of the EPC.

V. Both Parties lodged an appeal against this decision. Appellant I was the Opponent (hereinafter indicated as Opponent), Appellants II were the Patent Proprietors (hereinafter indicated as Proprietors).

At the oral proceedings the Opponent confirmed to only object to the subject-matter of the claims as granted for lack of inventive step (Article 56 EPC (1973)).
VI. The Proprietors submitted in writing and orally, inter alia, that neither starting from document (2) nor from document (3) the skilled person would have any reason for recombining an already hydrotreated low-boiling fraction of a F-T mixture with the corresponding high-boiling fraction prior of carrying out in a single step the hydrocracking / hydroisomerization of the whole F-T mixture. Nor would the person skilled in the art have any reason at all for combining these two citations one with the other, as they would go in totally different directions. Indeed, none of two options for removing the oxygenated compounds suggested in paragraph [0049] of document (2) involved the separated hydrotreatment of the low-boiling fraction and this citation was only focused on the simultaneous hydrocracking / hydroisomerization of the whole F-T mixture. On the contrary, document (3) not only taught to separately hydrotreat the low-boiling fraction, but also aimed at separately hydroisomerize the hydrotreated low-boiling fraction.

The Proprietors maintained also that document (2) would not disclose that the catalyst of this citation allowed to just selectively hydroisomerize the low-boiling hydrocarbon without any substantial hydrocracking.

Hence, not only the interpretation of document (2) made by the Opposition Division but also its combination with document (3) proposed by the Opponent were based on an ex post facto reasoning.

VII. The written and oral submissions of the Opponent may be summarised as follows.
The patented process represented just a minor simplification of the prior art disclosed in document (3). This simplification was obvious in view of the disclosure given e.g. in the first sentence of paragraph [0054] of document (2), as to the existence of a special catalyst capable of simultaneously promoting selective hydroisomerization of the low-boiling fraction and hydrocracking / hydroisomerization of the high-boiling fraction. Hence, it would be apparent to the skilled reader of document (3) that the use of the catalyst of document (2) allowed to simultaneously carry out in a single step the two hydrocracking / hydroisomerization steps previously carried out separately in the process of document (3). The patented subject-matter was, thus, rendered obvious by the combination of document (3) with document (2).

Moreover, the patented subject-matter represented just an obvious alternative embodiment of the process of document (2), i.e. it was just an attempt to prolong the validity in time of the monopoly already granted by document (2). Indeed, as also apparent from the fact that the two options mentioned in paragraph [0049] of document (2) were given just as two examples of how to remove undesired oxygenated compounds, the patented process represented a further option - actually the only remaining reasonable option - for removing such undesired compounds by means of hydrotreatment, before the simultaneous hydrocracking / hydroisomerization step of the process of document (2).

VIII. The Opponent requested that the decision under appeal be set aside and the patent be revoked.
The Proprietors requested that the decision under appeal be set aside and the patent be maintained or, alternatively, that the appeal of the Opponent be dismissed, or that the decision under appeal be set aside and the patent be maintained in amended form on the basis of the set of claims of the second or of the third auxiliary requests filed with letter of 9 March 2011.

Reasons for the decision

Proprietors' main request: maintenance of the patent as granted (rejection of the opposition)

1. The Board sees no reason to depart from the finding of the Opposition Division that the ground of opposition of lack of novelty does not prejudice the maintenance of the patent-in-suit as granted. No further reasons need to be given in this respect as the Opponent at the oral proceedings before the Board has explicitly stated to only object to the subject-matter of the claims as granted in view of the requirement of inventive step.

2. Inventive step (Article 56 EPC (1973)): claim 1

2.1 Claim 1 as granted (see above section II of the Facts and Submissions) defines a process for the production of middle distillates starting from a mixture of partially oxygenated, substantially linear hydrocarbons, of which at least 20% by weight have a boiling temperature higher than 370°C. The patented process is characterized in that:
- the starting mixture is separated into a low-boiling
and a high-boiling fraction, whereby the oxygenated
compounds are more abundant in the low-boiling fraction
(step "i");

- the low-boiling fraction is hydrotreated under
conditions providing no substantial hydrocracking of
the hydrocarbons (step "ii");

- the hydrotreated low-boiling fraction is (at least in
part) recombined with the high-boiling fraction and the
resulting mixture is hydrocracked in the presence of a
suitable catalyst (step "iii");

- at least one middle distillate fraction is separated
from the hydrocracked mixture (step "iv").

2.2 According to the established jurisprudence of the
Boards of appeal of the EPO, the appropriate starting
point for the inventive step assessment is to be
identified within the same technical field of the
claimed subject-matter by taking into account the
specific technical problem mentioned in the patent.

2.2.1 In the present case, the technical problem addressed in
the patent-in-suit appears reflected into the
statements given:

- in paragraph [0012], wherein the steps of the
  process of document (3) are defined as "numerous",
- in paragraph [0068], which stresses that the process of the invention allows to produce middle distillates with very high yields because it results in a very reduced quantity of final hydrocarbons having a boiling point lower than 150°C (i.e. a very reduced amount of losses is due to excessive hydrocracking).

Hence, the problem underlying the invention appears that of rendering available a process for upgrading F-T mixtures that

a) is simpler than the prior art

and

b) produces higher yields in middle distillates.

2.2.2 It is apparent and undisputed that, similarly to the subject-matter of claim 1 under consideration, the process of document (2) and that of document (3) attempt to overcome the two known difficulties inevitably associated to this upgrading process, i.e. the necessity of preliminarily removing the oxygenated impurities (as these are known to affect the activity of the catalyst promoting the hydrocracking and/or the hydroisomerization reactions) and the possibly substantial losses of useful hydrocarbons due to the undesired hydrocracking of the low-boiling hydrocarbons occurring while carrying out the desired hydrocracking of the high-boiling hydrocarbons.

It is also apparent and undisputed that the process of document (3) (which is older state of the art in respect of document (2)) is more complex than that disclosed in document (2). Hence, document (2) represents certainly a suitable starting point for the
assessment of inventive step in respect of the aspect "a)" of the problem underlying the invention identified above.

As to the aspect "b)" of the problem underlying the invention, the Board notes that document (2) discloses broad conversion ranges (see paragraph [0054] and Figure 1 of document (2)) and that also the tables of experimental data in document (3) report very variable yields in each step depending on the catalyst used. Hence, it is not possible from the reported conversion data alone to arrive at any sound conclusion as to which of these two prior art processes provides higher yields.

Nevertheless, the level of losses due to excessive cracking only appear to be minimized in document (3).

Indeed, this citation teaches to hydrocrack / hydroisomerize only the high-boiling fraction of the F-T mixture, whereas the low-boiling fraction of this latter is hydrotreated to remove oxygenated compounds and then selectively hydroisomerized under conditions explicitly required to apt at minimizing the extent of cracking (see in document (3) from column 1, line 39 to column 2, line 2; claim 1; Figure 1 and, in particular, column 4, lines 38 to 41, referring to the hydroisomerization of the already hydrotreated low-boiling fraction and reading "In catalytic hydroisomerization reactions feed cracking should be maintained as low as possible, usually less than 20% cracking, preferably less than 10%, more preferably less than about 5%.")

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Document (2), instead, after having stressed the complexity of the method used in document (3) for obtaining "higher yields", teaches that the use of an already known specific hydroisomerization catalyst allows to carry out with "satisfactory yields" (and possibly even without any prior removal of the oxygenated compounds) the simultaneous hydrocracking / hydroisomerization in a single step of the whole C\textsubscript{7+} fraction of the F-T mixture (compare in document (2) paragraphs [0018] and [0019] with paragraphs [0021], [0049], [0053] and [0054]). Hence, it is apparent to the skilled reader of this citation that the convenience of the process described therein lies essentially in its optimized balance between simplicity (which inevitably implies also process economy) and yields. This does not necessarily imply that the level of conversion achieved in the process of document (2) is as high as that of the more complex process of document (3).

The fact that the process of document (2) is manifestly not focused on the minimization of losses in general, or in particular of losses of low-boiling hydrocarbons, is also apparent from the first option disclosed in paragraph [0049] which does not provide any further indication as to what to do with the untreated low-boiling fraction. Thus, this citation appears to implicitly recognize as acceptable (possibly in view of the gain in process simplicity) even substantial losses of low-boiling hydrocarbons.

Hence, the Board concludes that whereas document (2) appears to disclose the simpler processes, i.e. to have already addressed the aspect "a)" of the problem
underlying the invention (see above point 2.2.1), document (3) appears to disclose the process with lesser losses and, thus, with higher yields and, thus, to represent a solution to the aspect "b)" of the problem underlying the invention.

2.2.3 Accordingly, the Board finds that each of these prior art processes represents a reasonable starting point for the assessment of inventive step.

Thus, and since the Opposition Division in its reasoning on inventive step has started from the embodiment of the process of document (2) in which the oxygenated impurities are removed by simply discarding sufficient amounts of the low-boiling fraction (the first option), whereas the Opponent has started from the process of document (3) as depicted in figure 1, the Board considers it appropriate in the present case to take into consideration both these possibilities.

2.3 Inventive step assessment starting from document (2)

2.3.1 The patented subject-matter differs from the embodiment of the process of document (2) from which the Opposition Division has started, only in that the separated low-boiling fraction is not simply removed, but upgraded to middle distillates. Hence, the process according to claim 1 under consideration is certainly more complex than that of this prior art and, thus, it cannot possibly represent an improvement in process simplicity. Accordingly, this aspect of the problem underlying the invention is certainly not relevant for determining the technical problem actually solved by the patented subject-matter.
On the contrary, the upgrading function of the additional process steps distinguishing the process of claim 1 from the process of document (2) renders credible that, as also implicitly acknowledged by the Opposition Division in the decision under appeal, the patented subject-matter actually solves vis-à-vis this prior art the above-identified aspect "b)" of the technical problem addressed in the patent-in-suit, i.e. the provision of a process for upgrading F-T mixtures with higher yields.

2.3.2 The solution to this problem provided by the patented subject-matter consists in upgrading also the low-boiling fraction, by additionally hydrotreating it and then recombining the hydrotreated low-boiling fraction with the high-boiling fraction, followed by the simultaneous hydrocracking / hydroisomerization of the recombined mixture.

The Board considers, for the following reasons, that neither document (2) alone nor its combination with document (3) would motivate the skilled person, searching for a solution to the posed problem, to the modification of the prior art resulting in the patented subject-matter.

2.3.3 When considering document (2) in isolation, the skilled person would note that, as also observed in the decision under appeal, this citation suggests in the second option the hydrotreatment of the whole F-T mixture. In the opinion of the Board, this teaching would at most motivate the skilled person searching for higher yields to simply use such alternative
possibility. Thus, the disclosure of document (2) would at most suggest to the skilled person searching for an increase in yields to avoid the first option (i.e. to avoid any additional separation of the low-boiling fraction at all) and/or to recombine any possibly already available low-boiling fraction (e.g. those allegedly inevitably recovered from the synthetic process) with the rest of the F-T mixture before carrying the hydrotreatment of the whole F-T mixture according to the second option.

Accordingly, the Board finds, contrary to the conclusions of the Opposition Division, that the patented subject-matter provides a solution to the technical problem of increasing the yields of the process of document (2) that is not rendered obvious by the disclosure of this citation per se.

2.3.4 The Board considers it appropriate to mention again at this point that the skilled reader of document (2) derives from such citation the teaching that the convenience of the process disclosed therein lies essentially in the optimized balance between its yields and its simplicity (see the discussion on this citation already reported above at point 2.2.2). Hence, process modifications (such as those needed to arrive at the patented subject-matter) that are substantially more complex than any of the two options mentioned in paragraph [0049] cannot be considered, as maintained by the Opponent, to represent an evident option for realizing a further embodiment of the same invention claimed in document (2), already for the reason that the increase in process complexity associated to such
modifications appears likely to compromise the overall convenience of the resulting process.

2.3.5 The Board notes further that the skilled person, who is searching for a solution to the posed problem and starts from the first option of document (2), certainly takes into consideration document (3) as well, since this latter citation teaches how to upgrade low-boiling fractions. However, none of these documents teaches the possibility of recombining an already hydrotreated low-boiling fraction with the high-boiling fraction prior of any hydrocracking.

Hence, in case the skilled person would have contemplated the possibility of up-grading the low-boiling fraction produced by the first option of the process of document (2) according to the relevant teachings in document (3), these teachings would offer only one option, namely that of carrying out separated hydroisomerization and separated hydrotreatment of the low-boiling fraction, thereby arriving at a process substantially identical to that of document (3), rather than to the process of claim 1 as granted.

The Opponent appears instead to interpret the disclosure of document (2) as if this citation would attribute to the specific catalyst mentioned therein the ability of simultaneously producing in a single step substantially the same hydrocracking / hydroisomerization of low-boiling and high-boiling hydrocarbons occurring in separate steps in the process of document (3). This is found incorrect already because, as discussed above at point 2.2.2, the skilled reader of documents (2) and (3) in combination has no
reason for expecting the losses due to the undesired cracking of the low-boiling hydrocarbons occurring in the process of document (2) during the simultaneous hydrocracking / hydroisomerization of both the low-boiling and the high-boiling hydrocarbons, to be as low as those obtained in the selective hydroisomerization with minimized cracking of just the low-boiling hydrocarbons in the process of document (3). Hence, it is not apparent to the skilled person desiring to increase the yields of the upgrading process of document (2) and considering document (3) that the same level of up-grading yields obtainable by the two step sequence proposed in document (3), is also obtainable in the modification of the process of document (2) corresponding to the subject-matter of claim 1 under consideration.

2.3.6 For the sake of completeness the Board finds it appropriate to indicate that the patented subject-matter would not be obvious even in case the skilled person would start from the other embodiment of the process of document (2) wherein the removal of the oxygenated impurities is carried out according to the second option of paragraph [0049], i.e. from the process in which the whole (non-fractionated) F-T mixture is firstly hydrotreated and then subjected to a single hydrocracking / hydroisomerization step in the presence of the specified catalyst.

It is apparent to the Board that this prior art process does not imply the losses of low-boiling hydrocarbons apparently associated to the first option. Hence, the patented process cannot even be expected to credibly achieve yields that are higher than this prior art.
Therefore, and since the patented subject-matter is manifestly more complex than the process of document (2) according to the second option as well, the sole technical problem credibly solved by the process of claim 1 vis-à-vis this prior art is that of rendering available a further process for upgrading F-T mixtures, i.e. just the provision of an alternative.

Nevertheless, in the opinion of the Board, the skilled person cannot derive neither from document (2) itself nor from document (3) any suggestion that would lead to the solution offered by the patented invention.

Indeed, the subject-matter of claim 1 differs from the process according to the second option of document (2) in that, rather than carrying out the hydrotreatment in a single step on the whole F-T fraction, it requires to carry out the following process steps:

a) to fraction the F-T mixture in the two fractions with different boiling ranges,

b) to separately hydrotreat the obtained low-boiling fraction

and

c) to recombine the hydrotreated low-boiling fraction with the high-boiling fraction prior of any hydrocracking.

As discussed already above at point 2.3.5, neither document (2) nor document (3) describe the step "c)".
Hence, also in case the skilled person would have contemplated the possibility of replacing the hydrotreatment of the whole F-T mixture in the second option of the process of document (2) by a separate hydrotreatment of just the low-boiling fraction thereof as suggested in document (3), still the combination of the teaching in these citations would only render obvious to further continue with the separated hydroisomerization of the hydrotreated low-boiling fraction as well, thereby arriving at a process substantially identical to that of document (3).

Accordingly, also in case that the prior art of departure is the process of document (2) according to the second option of paragraph [0049] and, thus, that the technical problem solved is just the provision of an alternative to this latter, still the patented subject-matter cannot possibly be rendered obvious by the remaining disclosure in document (2) or by the combination of the technical teachings of documents (2) and (3).

2.4 Inventive step assessment starting from document (3)

The Board notes that the process of document (3) requires, after having separated the F-T mixture into a low-boiling and a high-boiling fraction and after having hydrotreated the low-boiling fraction, two distinct final reactions with hydrogen in order to, on the one side, hydrocrack / hydroisomerize the high-boiling fraction and to, on the other side, hydroisomerize with minimized hydrocracking the already hydrotreated low-boiling fraction. The subject-matter of claim 1 under consideration requires instead to
recombine the already separated and hydrotreated low-boiling fraction with the high-boiling traction and then to carry out on the resulting mixture a single hydrocrack / hydroisomerization step. Hence the Board concurs with the Opponent that the technical problem credibly solved by the patented process vis-à-vis this prior art consists in a simplification of this latter.

The Opponent has argued that the skilled person, searching for a solution to this technical problem, would find disclosed in document (2) that a specific catalyst allows to simultaneously carry out hydrocracking / hydroisomerization of the whole "C₇+ fraction", i.e. of both low-boiling and high-boiling linear hydrocarbons and, thus, would be prompted to recombine the hydrotreated low-boiling fraction with the high-boiling one and to carry out on the recombined mixture a single hydrocrack / hydroisomerization step, thereby arriving at the process of the patent-in-suit.

As indicated already above at point 2.3.5, this reasoning of the Opponent implies the assumption that the reactions occurring during the simultaneously hydrocracking / hydroisomerization the whole "C₇+" fraction according to the process of document (2) would substantially be the same that occur separately in the two distinct hydrocracking / hydroisomerization steps of document (3).

However, as also indicated already above at points 2.2.2 and 2.3.5, no minimization of losses due to excessive cracking of low-boiling hydrocarbons is implied in the process of document (2). Hence, it is found erroneous to equate the teaching of this citation
as an instruction on how to carry out in a single step substantially the same hydrocracking / hydroisomerization occurring in the two separated steps of document (3).

Moreover, as also already indicated above at points 2.3.5 and 2.3.6, none of these citations discloses the possibility of recombining an hydrotreated low-boiling fraction with the high-boiling fraction prior of hydrocracking / hydroisomerization.

Thus, the Board finds that the patented subject-matter does not descend in an obvious manner from the combination of document (3) with document (2) either.

2.5 The Board concludes, therefore, that the Opponent has not succeeded in rendering credible that the prior art renders obvious the subject-matter of claim 1 as granted.

3. Inventive step (Article 56 EPC (1973)): claims 2 to 36.

The remaining granted claims define preferred embodiments of the process of claim 1. Hence, the Board finds that the same reasons indicated above for acknowledging the presence of an inventive step for claim 1 apply identically also to the subject-matter of the dependent claims. Accordingly, also claims 2 to 36 are found to comply with the requirements of Article 56 EPC (1973) in view of the available prior art.

4. The Board concludes that also the ground of opposition of lack of inventive step does not prejudice the maintenance of the patent as granted.
Order

For these reasons it is decided that:

1. The decision under appeal is set aside.

2. The opposition is rejected.

The Registrar:                The Chairman:

D. Magliano                  P.-P. Bracke