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**D E C I S I O N**  
**of 4 April 2003**

**Case Number:** T 0539/99 - 3.3.6

**Application Number:** 93200165.4

**Publication Number:** 0553920

**IPC:** C10G 49/00

**Language of the proceedings:** EN

**Title of invention:**  
Hydrotreating process

**Patentee:**  
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**Opponent:**  
ExxonMobil Research and Engineering Company  
Kvaerner Process Technology Limited

**Headword:**  
Hydrotreating/SHELL

**Relevant legal provisions:**  
EPC Art. 54, 56

**Keyword:**  
"Novelty (yes)"  
"Inventive step (no) - reformulation of the technical problem  
addressed in the patent in suit in less ambitious terms"

**Decisions cited:**  
T 0506/95, T 0298/93, T 0020/81

**Catchword:**  
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Case Number: T 0539/99 - 3.3.6

**D E C I S I O N**  
**of the Technical Board of Appeal 3.3.6**  
**of 4 April 2003**

**Appellant:**  
(Proprietor of the patent)

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**Decision under appeal:**

**Decision of the Opposition Division of the  
European Patent Office posted 16 March 1999  
revoking European patent No. 0 553 920 pursuant  
to Article 102(1) EPC.**

**Composition of the Board:**

**Chairman:** P. Krasa  
**Members:** L. Li Voti  
C. Rennie-Smith

## Summary of Facts of Submissions

- I. The present appeal is from the decision of the Opposition Division to revoke European patent No. 0 553 920, concerning a reactor vessel suitable for hydrotreating a hydrocarbon oil.
- II. Two notices of opposition were filed against the patent, wherein the Respondents 01 and 02 (Opponents 01 and 02), sought revocation of the patent on the grounds of Articles 100(a), (b) and (c) EPC.

The oppositions were based inter alia upon the following documents:

(4): B-A-1420248

(5): WO-A-8805767

- III. During the opposition proceedings the Appellant (Patent Proprietor) filed two amended sets of claims to be considered, respectively, as the main and the auxiliary request.

The apparatus claim 14 of the main request was objected to by the Respondents under Article 123(2) EPC.

In its decision, the Opposition Division found the claimed process according to both the main and the auxiliary request to be novel but not to involve an inventive step in the light of the teaching of document (4).

As regards the apparatus claim of the main request, it remarked, however, that this claim complied with the requirements of Articles 123(2) and (3) EPC and was novel and inventive over the cited prior art.

IV. An appeal was filed against this decision.

The request filed by the Appellant with the statement of the grounds of appeal consisted only of an apparatus claim corresponding to claim 14 of the main request as filed at first instance.

This claim reads as follows:

"1. Reactor vessel suitable for hydrotreating a hydrocarbon oil which is substantially liquid at process conditions by a process which comprises:  
(i) contacting partly hydrotreated hydrocarbon oil obtained in step (iv) described hereinbelow, at elevated temperature and pressure in the upper catalyst bed with a hydrotreating catalyst in the presence of clean hydrogen containing gas,  
(ii) separating the effluent of step (i) into hydrotreated hydrocarbon oil and used hydrogen containing gas, which hydrotreated hydrocarbon oil is removed from the process,  
(iii) contacting fresh hydrocarbon oil at elevated temperature and pressure with a hydrotreating catalyst in the lower catalyst bed in the presence of used hydrogen containing gas obtained in step (ii),  
(iv) separating the effluent of step (iii) into partly hydrotreated hydrocarbon oil and contaminated hydrogen containing gas, which contaminated hydrogen containing gas is removed from the process, and

(v) transporting partly hydrotreated hydrocarbon oil obtained in step (iv) to step (i), whereby the hydrogen partial pressure in the upper catalyst bed is higher than in the lower catalyst bed in which vessel:

(a) above the upper zone for retaining a catalyst bed is situated an inlet for gas and an inlet for liquid,  
(b) between the upper and lower zone for retaining a catalyst bed is situated a separating means for separating liquid and gas,  
(c) between the upper zone for retaining a catalyst bed and the separating means is situated an outlet for liquid,  
(d) between the separating means and the lower zone for retaining a catalyst bed is situated an inlet for liquid,  
(e) below the lower zone for retaining a catalyst bed is present an outlet for gas and an outlet for liquid, or an outlet for liquid and gas, to which vessel a means is attached for transporting liquid obtained from the outlet for liquid situated below the lower zone for retaining a catalyst bed to the inlet for liquid situated above the upper zone for retaining a catalyst bed, to which vessel is also attached gas cleaning means and recycle means to the gas inlet of the upper zone for retaining a catalyst bed."

This claim differs from the granted apparatus claim insofar as it requires that gas cleaning means and recycle means to the gas inlet of the upper zone for retaining a catalyst bed be attached to the vessel.

Oral proceedings, which were not attended by Respondent 02, were held before the Board on 4 April 2003.

- V. The Appellant put forward in writing and during the oral proceedings that
- all the features of the amended claim were supported by the original documents of the application from which the patent was granted;
  - process step (iv) of claim 1, requiring that the contaminated hydrogen containing gas effluent be removed from the process, implied the removal of the gas from the reaction vessel and did not exclude its recirculation into the same vessel after cleaning;
  - the technical problem underlying the claimed invention consisted in the provision of an apparatus for reducing the sulfur content of a substantially liquid hydrocarbon oil to a very low level by hydrotreating the oil in a way which minimizes capital expenditure and avoids the disadvantages of counter-current operations; document (5), which did not disclose the use of a reactor vessel for the reduction of the sulfur content of a hydrocarbon oil by hydrotreatment, did not represent therefore the closest prior art;
  - the comparative tests provided in the patent in suit showed that this technical problem had been successfully solved and that it was possible to obtain a hydrocarbon oil having a much lower

sulfur content than that obtained by carrying out a hydrotreatment in an apparatus such as that used in the process of document (4);

- moreover, even though the steps of the process carried out in the apparatus of the patent in suit were similar to those of the process disclosed, e.g., in document (4), the prior art did not suggest the use of one single reactor vessel in a hydrotreating process not involving countercurrent operations in order to minimize capital expenditure;
- furthermore, the skilled person, looking for an alternative apparatus for carrying out a hydrotreatment process as disclosed in document (4), would not have taken into consideration the reactor vessel of document (5), which did not contain any attached means for cleaning and recycling the effluent gas to its upper section, since this prior art document did not suggest its use in a hydrotreating process and taught moreover to avoid the recycling of the gaseous effluent;
- finally, even considering the teaching of document (5), the skilled person would not have foreseen the reduction of the sulfur level achieved by using the claimed apparatus in the hydrotreatment of a hydrocarbon oil; furthermore, the reactor vessel disclosed therein did not contain the separating means for gas and liquid between the two catalytic beds used in the patent in suit, which separating means were responsible for the achievement of a very low sulfur level.

VI. The Respondents submitted inter alia the following arguments:

- claim 1 did not comply with the requirements of Article 123(2) EPC since the application as filed did not contain any disclosure of attached gas cleaning means and recycle means to the gas inlet of the upper zone for retaining a catalyst bed;
- the process step (iv) of claim 1, requiring the effluent contaminated gas to be removed from the process, contradicted the apparatus features requiring the effluent gas to be cleaned and recirculated into the process; moreover, the features relating to the gas cleaning and recycle means attached to the reactor vessel and not being part of the vessel itself contradicted the opening wording of the claim relating only to a reactor vessel; therefore, the patent in suit did not comply with the requirements of Article 83 EPC and the claim did not comply with the requirements of Article 84 EPC;
- the claimed subject-matter lacked novelty in the light of document (5), which disclosed a reactor vessel comprising features (a) to (e) of claim 1 of the patent in suit and also comprising attached thereto means for cleaning hydrogen gas and for recirculating the effluent liquid with the used hydrogen gas dissolved therein;



- the claimed subject-matter lacked an inventive step since it was obvious to use a single catalytic reactor vessel, such as that of document (5), instead of the two reactors disclosed in the process of document (4) in order to save costs;
- finally, the comparative test contained in the patent in suit was not suitable for showing that a hydrotreatment process carried out in a reactor vessel as claimed provided a hydrocarbon oil having a lower sulfur content than that obtained by means of a process as described in document (4).

VII. The Appellant requests that the decision of the first instance be set aside and the patent be maintained on the basis of the claim filed with the statement of the grounds of appeal.

The Respondents request that the appeal be dismissed.

VIII. At the end of the oral proceedings, the chairman announced the decision of the Board.

## **Reasons for the Decision**

1. *Articles 83, 84 and 123 EPC*

1.1 The Board is satisfied that claim 1 complies with the requirements of Articles 83, 84 and 123(2) and (3) EPC.

In particular, the Board finds that the process step (iv) of claim 1, requiring that the effluent contaminated gas be removed from the process (see

point IV above), implies that the contaminated gas effluent exiting the reactor is not reintroduced as such into the process. Therefore, this wording allows the contaminated gas effluent to be cleaned and recirculated into the reactor vessel as claimed in claim 1.

Moreover, since the word "attached" means in the Board's view "connected by some means", the wording of claim 1 is clear and relates to an apparatus consisting of the described reactor vessel with the indicated cleaning and recirculating means attached thereto.

1.2 Since the appeal fails on the grounds mentioned hereinbelow there is no need to give further details.

2. *Novelty*

2.1 The Board is also satisfied that the apparatus described in document (5) does not detract from the novelty of the claimed subject-matter.

The reactor vessel disclosed therein comprises in fact all the features (a) to (e) of claim 1 and means for recirculating the liquid exiting the bottom of the reactor to its upper section (see page 23, lines 5 to page 24, line 15 in connection with Figure 2), i.e.

- (a) an inlet for gas and an inlet for liquid above the upper zone for retaining a catalyst bed (see entering points of lines 120 and 136 above catalyst bed 103),

- (b) separating means for separating liquid and gas between the upper and lower zone for retaining a catalyst bed (see tray 123 and orifice 137 between catalyst beds 102 and 103);
- (c) an outlet for liquid between the upper zone for retaining a catalyst bed and the separating means (see line 122);
- (d) an inlet for liquid between the separating means and the lower zone for retaining a catalyst bed (see line 108);
- (e) an outlet for gas and an outlet for liquid below the lower zone for retaining a catalyst bed (see lines 110 and 138);

means attached thereto for transporting liquid obtained from the outlet for liquid situated below the lower zone for retaining a catalyst bed to the inlet for liquid situated above the upper zone for retaining a catalyst bed (see the right part of Figure 2 between lines 110 and 120).

As regards feature (b) the Appellant argued during oral proceedings that the separating means according to this feature were different from those of the reactor of document (5). However, the wording of claim 1 does not specify further constructional features of such separating means. Therefore it encompasses any separating means for gas and liquid and thus also those disclosed in document (5).

However, this reactor vessel does not contain, attached thereto, cleaning and recycling means for the effluent gas, separately from the effluent liquid, as correctly remarked on page 6, point 2 of the decision of the opposition division.

2.2 Since the appeal fails on the grounds mentioned hereinbelow there is no need to give further details.

3. *Inventive step*

3.1 Most suitable starting point

The patent in suit, and in particular the subject-matter of claim 1, relates to a reactor vessel suitable for hydrotreating a substantially liquid hydrocarbon oil.

As explained in the patent in suit, the forthcoming environmental legislation would require a more severe limitation of the sulfur content in hydrocarbon oil. Therefore it was desirable to provide a process of hydrotreatment able to reduce the sulfur content of a hydrocarbon oil to a very low level. Moreover, it was desirable to reduce the capital investment in the apparatus necessary for carrying out such a process and to avoid countercurrent operations (see page 2, lines 5 to 15 and 44 to 58).

The most suitable starting point for assessing inventive step is, according to the jurisprudence of the Boards of Appeal of the EPO, a document (if available) conceived for the same purpose as the claimed invention and not a document having the most features in common with the claimed subject-matter but

relating to a different purpose (see T 298/93, point 2.2.2 of the reasoned decision and T 506/95, point 4.1 of the reasoned decision, neither published in the OJ EPO).

Document (5), though disclosing, as mentioned in point 2.1 above, a reactor vessel differing from that of claim 1 only insofar as it has no cleaning and recycling means for the effluent gas attached thereto, does not address the technical problem of providing a reactor vessel for reducing the sulfur content of a hydrocarbon oil by hydrotreatment.

Therefore, the Board is of the opinion that this document cannot be considered a suitable starting point for discussing the inventiveness of the claimed subject-matter.

Document (4), mentioned on page 2, lines 12 to 15 of the patent in suit, discloses a method for hydrotreating a hydrocarbon oil in order to provide a low sulfur content of even less than 0.5% by weight (see page 1, lines 60 to 76).

This known process comprises all the process steps (i) to (v) and the pressure requirements of claim 1, thus not making use of any countercurrent operation, as correctly indicated in the decision of the opposition division (page 3, points 3.2 and 3.3). However, the apparatus used in this known process requires, differently from the apparatus of claim 1 of the patent in suit, two separate catalytic reactor vessels; moreover, the separating means between the two catalyst

beds according to process step (ii) are outside of the reactor vessels (see page 4, lines 90 to 110 and page 6, lines 16 to 34 in combination with Figure 1, reactors 3 and 14 and separator 20).

Document (4), dealing with the same kind of process indicated in the patent in suit and representative of the state of the art mentioned therein, is thus in the Board's view the most reasonable starting point for assessing inventive step.

### 3.2 Technical problem

As argued by the Appellant, the technical problem underlying the patent in suit can be defined in accordance with the description of the patent in suit as the provision of an apparatus for reducing the sulfur content of a substantially liquid hydrocarbon oil to a very low level by hydrotreating the oil in a way which minimizes capital expenditure and avoids the disadvantages of counter-current operations (see page 2, lines 5 to 15 and 44 to 45). The sulfur level obtainable by means of the claimed reactor vessel is moreover according to the Appellant lower than that obtainable by means of the apparatus described in document (4).

However, since the process of document (4) does not involve any countercurrent operations and already provides a hydrocarbon oil having a low level of sulfur (see point 3.1 above), the overcoming of the disadvantages of countercurrent operations and the achievement of a low level of sulfur cannot be

considered to be part of the overall technical problem underlying the claimed invention as seen in the light of the document considered to represent the starting point for the assessment of inventive step.

Furthermore, the patent in suit does not establish credibly that the use of the claimed reactor vessel leads under any circumstance to a lower sulfur content than that achieved in document (4). As already indicated in the decision of the first instance (page 4, point 4.2), the comparative test contained in the patent in suit is not apt at to provide any evidence of this alleged advantage. In fact, this test reports a comparison of a hydrotreating process in the reactor vessel of the patent in suit with a similar process carried out in the same reactor vessel, i.e. in only one catalytic reactor, but without the process steps (ii) and (iii), i.e. in the comparative process the gas and liquid exiting the first catalytic bed were not separated, no hydrocarbon oil exiting the first catalytic bed was removed and no fresh hydrocarbon oil was added to the top of the second catalytic bed (see page 4, lines 33 to 37). Therefore, this comparative test cannot be considered in the Board's view as representative of the process of document (4) which requires process steps (ii) and (iii), as explained in point 3.1 above.

The Appellant argued during oral proceedings that the separation means used between the two catalytic beds in the single reactor of the patent in suit were responsible for the achieved low sulfur level. However, as already explained in point 2.1 above, the wording of

claim 1 does not define any constructional feature of such separating means and, moreover, no evidence was submitted that the separating means are responsible for the achievement of the low sulfur content.

Finally, the fact that document (4) does not explicitly disclose a low sulfur content of 0.06% as obtained in the example of the patent in suit cannot be either considered as evidence that the claimed reactor leads to a lower sulfur content than the process of document (4). The Board also observes that the patent in suit does not indicate any upper limit for the desired low sulfur content: it just states that an unspecified low sulfur content is desirable, as similarly stated in document (4) (page 1, lines 61 to 77).

The Board concludes therefore that the partial technical problem regarding the achievement of a lower sulfur content than in document (4) has not been supported by any evidence and has to be disregarded in the assessment of inventive step as not being credibly solved (see T 20/81, OJ EPO 1982, 217, point 3 of the reasons).

Therefore, the technical problem underlying the claimed invention must be reformulated in less ambitious terms as the provision of an apparatus for hydrotreating hydrocarbon oil in a way which minimizes capital expenditure.

The Board has no reason to doubt that the subject-matter of claim 1 solved the technical problem mentioned above.



### 3.3 Evaluation of inventive step

A skilled person, faced with the technical problem indicated above, would have looked in the prior art for suggestions directed at simplifying the hydrotreatment apparatus of document (4) and thus, for example, at ways for reducing the number of reactor and separation vessels needed in the process.

Therefore, he would have investigated not only the reactor vessels specifically known for hydrotreating but all known reactor vessels suitable for containing catalytic beds and for carrying out gas/liquid hydrogenation reactions and separations.

In the Board's view the skilled person, aware of the existence of a reactor as disclosed in document (5), capable of containing two catalytic beds and separating means for gas and liquid (see point 2.1 above) and suitable for reducing the costs of a multi-stage heterogeneous gas/liquid hydrogenation process (see page 3, lines 15 to 29), would have recognised this reactor vessel to be suitable for carrying out the type of reaction and the separation steps required by the process of document (4) and in particular would have recognised it to be a suitable replacement for the two catalytic reactors 3 and 14 and the separator 20 (see point 3.1 above) used in that process.

Moreover, even though the specific apparatus used in document (5) does not require any cleaning and recycle means for the effluent hydrogen gas and the effluent gas is instead purged (see page 3, lines 30 to 32; page 9, lines 1 to 5; page 18, lines 7 to 11), this document also teaches that the recycling of gas is

usual in hydrogenation processes (see page 3, lines 15 to 20 and page 18, lines 11 to 14) but it is not needed on economic grounds for carrying out hydrogenation of aldehydes or other unsaturated organic compounds in the disclosed reactor vessel (see page 3, lines 24 to 29 and page 18, lines 7 to 10).

Therefore, in the Board's judgement this document would not dissuade the skilled person from using, connected to the reactor vessel, cleaning and recirculating means for the effluent gas if needed by the specific reaction process as, for example, in the case of the hydrotreatment of hydrocarbon oils of document (4).

Since there did not exist any prejudice in the prior art against the use of such a reactor vessel for the hydrotreatment of a hydrocarbon oil and the Appellant has also not provided any evidence to the contrary, the Board concludes that it was obvious for the skilled person to use the reactor vessel of document (5) for simplifying and thus reducing the costs of the hydrotreating process disclosed in document (4).

Consequently, the subject-matter of claim 1 does not meet the requirements of Article 56 EPC.

**Order**

**For these reasons it is decided that:**

The appeal is dismissed.

The Registrar:

The Chairman:

G. Rauh

P. Krasa