Internal distribution code:

(A) [-] Publication in OJ
(B) [-] To Chairmen and Members
(C) [-] To Chairmen
(D) [X] No distribution

Datasheet for the decision of 25 May 2016

Case Number: T 0141/14 - 3.3.05

Application Number: 01125186.5

Publication Number: 1203611

IPC: B01D53/94, F01N3/20

Language of the proceedings: EN

Title of invention:
Process and device for the selective catalytic reduction of nitrogen oxides in oxygen-rich exhaust gas

Patent Proprietor:
Umicore AG & Co. KG

Opponent:
Johnson Matthey Public Limited Company

Headword:
NOx selective reduction/UMICORE

Relevant legal provisions:
EPC Art. 54(1), 54(2), 56, 83, 123(2)
EPC R. 139

Keyword:
Main request - correction of error - not immediately evident that nothing else could have been intended - amendment not allowable
Sufficiency of disclosure - (yes)
Auxiliary request - inventive step (yes) - non-obvious alternative

Decisions cited:

Catchword:

Europäisches Patentamt
European Patent Office
Office européen des brevets

Beschwerdekammern
Boards of Appeal
Chambres de recours

European Patent Office
D-80298 MUNICH
GERMANY
Tel. +49 (0) 89 2399-0
Fax +49 (0) 89 2399-4465

Case Number: T 0141/14 - 3.3.05

D E C I S I O N
of Technical Board of Appeal 3.3.05
of 25 May 2016

Appellant: (Patent Proprietor)	Umicore AG & Co. KG Rodenbacher Chaussee 4 63457 Hanau-Wolfgang (DE)
Representative:	Vossius & Partner Patentanwälte Rechtsanwälte mbB Siebertstrasse 3 81675 München (DE)
Respondent: (Opponent)	JOHNSON MATTHEY PUBLIC LIMITED COMPANY 5th Floor, 25 Farringdon Street London EC4A 4AB (GB)
Representative:	Schön, Christoph Dr. Schön, Neymeyr & Partner mbB Bavariaring 26 80336 München (DE)
Decision under appeal:	**Decision of the Opposition Division of the European Patent Office posted on 11 November 2013 revoking European patent No. 1203611 pursuant to Article 101(3)(b) EPC.**

Composition of the Board:

Chairman	H. Engl
Members:	J.-M. Schwaller
	O. Loizou

Summary of Facts and Submissions

I. The present appeal lies from the decision of the opposition division to revoke European patent No. 1 203 611.

II. Claim 1 of the main request underlying said decision reads as follows:

"1. An exhaust gas treatment unit (1) for the selective catalytic reduction of nitrogen oxides under lean exhaust gas conditions which contains:

(a) a converter housing (5) containing an oxidation catalyst comprising platinum on active alumina;

(b) a convertor [sic] housing (3) containing a catalyst (4) which contains:

(i) catalytically active SCR components wherein the SCR components contain a solid acid system of titanium dioxide and vanadium oxide or wherein the SCR components contain at least one zeolite, wherein the zeolites may be present in the acid H form or may be exchanged with metal ions; and

(ii) at least one NOx storage component which contains at least one compound of elements selected from the group consisting of alkali metals, alkaline earth metals and cerium; and

wherein the catalyst (4) does not contain catalytically active platinum group metals; and

(c) a point of injection of urea between the convertor housing (5) and the convertor housing (3)."

III. The opposition division decided that amending claim 1 by substituting "vanadium oxide" for "vanadium" was an allowable correction under Rule 139 EPC, satisfying the requirements of Article 123(2) EPC.

Further, the amendment that "the catalyst (4) does not contain catalytically active platinum group metals" was based on the disclosure on page 4, second paragraph and page 6, third paragraph, and thus also met the requirements of Article 123(2) EPC.

The opposition division furthermore held that the invention was disclosed in a manner sufficiently clear and complete for it to be carried out by a person skilled in the art (Article 83 EPC) and that the subject-matter of claim 1 of the main request was novel over document:

D1: WO 00/21647 A1

According to the contested decision, the subject-matter of claim 1 of the main request (see point II above) did not, however, involve an inventive step over the closest state of the art, as represented by document D1 in combination with the teaching of either of documents

D8: EP 0 283 913 A2 or

D9: Gieshoff J. et al.: "*Improved SCR Systems for Heavy Duty Applications*", SAE Technical Papers Series, SAE 2000 World Congress, 6-9 March 2000.

The claims of the sole auxiliary request underlying the decision were held to infringe the requirements of Article 123(3) EPC.

IV. With the grounds of appeal dated 21 March 2014, the proprietor (appellant) contested the decision and argued in particular that D1 neither disclosed the specific combination of components of catalyst (4), nor the presence of active alumina on the oxidation catalyst, nor were the oxidation catalyst and catalyst (4) located in separate housings.

As none of the prior art documents disclosed the combination of components of catalyst (4), the claimed subject-matter was not obvious from the prior art.

V. By letter of 7 August 2014, the opponent (respondent) argued that the claims of the main request infringed the requirements of Articles 123(2), 83, 54 and 56 EPC. It argued in particular that the claimed subject-matter was not novel in the light of D1 and that it lacked inventive step having regard to D1 in combination with the teaching of either of documents D8 or

D7: EP 0 896 831 A1.

VI. With letter of 25 April 2016, the appellant submitted four requests, namely a main request which was identical to the main request underlying the contested decision (see point II above), and three auxiliary requests.

Independent claims 1 and 8 of the first auxiliary request read as follows:

"*1. An exhaust gas treatment unit (1) for the selective catalytic reduction of nitrogen oxides under lean exhaust gas conditions which contains:*

(a) a converter housing (5) containing an oxidation catalyst comprising platinum on active alumina;

(b) a convertor housing (3) containing a catalyst (4) which contains:

(i) catalytically active SCR components ***~~wherein the SCR components contain a solid acid system of titanium dioxide and vanadium oxide or~~*** *wherein the SCR components contain at least one zeolite, wherein the zeolites may be present in the acid H form or may be exchanged with metal ions; and*

(ii) at least one NOx storage component which contains at least one compound of elements selected from the group consisting of alkali metals, alkaline earth metals and cerium; and

wherein the catalyst (4) does not contain catalytically active platinum group metals; and

(c) a point of injection of urea between the convertor housing (5) and the convertor housing (3)."

"8. A process for removing nitrogen oxides from lean exhaust gas from an internal combustion engine by selective catalytic reduction using ammonia, wherein the exhaust gas is passed through an exhaust gas treatment unit (1) as defined in any of claims 1 to 7, wherein the exhaust gas passes over the oxidation catalyst, passes the point of injection of urea and then passes over catalyst (4); and wherein ammonia which is generated by hydrolysis of urea, is at least occasionally supplied, and wherein the at least one NOx storage component absorbs the nitrogen oxides from the exhaust gas during operational phases of the engine

with exhaust gas temperatures below the light-off temperature for the SCR components and the nitrogen oxides are desorbed at exhaust gas temperatures above the light-off temperature for selective catalytic reduction by supplying ammonia and reacting with ammonia, together with the nitrogen oxides present in the exhaust gas, on the SCR components to give nitrogen and water."

Dependent claims 2 to 7 and 9 to 11 represent specific embodiments of independent claims 1 and 8, respectively.

VII. At the oral proceedings, which took place on 25 May 2016, the discussion focused on the issues of Articles 83, 123(2), 54 and 56 EPC. Regarding inventive step of the first auxiliary request, the respondent argued that D1 represented the closest state of the art and that the subject-matter of claim 1 of this request was obvious in view of D1 taken in combination with the teaching of

D6: EP 1 027 919 A2.

The respondent further objected to the admissibility of the first and third auxiliary requests. The board admitted the first auxiliary request into the proceedings.

VIII. At the end of the oral proceedings, the parties' requests were as follows:

The appellant requested that the decision under appeal be set aside and that the patent be maintained in amended form on the basis of the claims according to the main request, or alternatively, on the basis of one

of the sets of claims according to the first to third auxiliary requests, all requests as filed with letter of 25 April 2016.

The respondent requested that the appeal be dismissed.

Reasons for the Decision

1. Main request - Amendments

1.1 For the board, the amendment of the feature "vanadium" to "vanadium oxide" does not meet the requirements of Rule 139 EPC, because the proposed correction is only one of several options which would occur to the skilled person.

1.1.1 According to the passage bridging pages 2 and 3 of the application as filed, the "*solid acid system of titanium oxide and vanadium*" is described as optionally further containing "*at least one component selected from the group consisting of tungsten oxide (WO_3), molybdenum oxide (MoO_3), silicon dioxide,* ***sulfate*** *and zeolites*", so a combination of vanadium and sulfate is clearly one of the options envisaged by the application as filed.

1.1.2 Appellant's argument that the system titanium oxide/ vanadium oxide was commonly known as solid acid and as SCR catalyst is accepted by the board. However, as long as there exists at least one further possibility of correction - for instance the one indicated in point 1.1.1 above - the criteria of Rule 139 EPC that "the correction must be obvious in the sense that nothing else would have been intended than what is offered as the correction" is not fulfilled.

1.2 Since there is no basis either in the application as filed for the amendment by which "vanadium oxide" replaces "vanadium", the subject-matter of claim 1 at issue extends beyond the content of the application as filed (Article 123(2) EPC).

1.3 It follows from the above considerations that the main request cannot be allowed.

2. First auxiliary request - Admissibility

This request is admitted into the appeal proceedings because the negative opinion of the board regarding the substitution of "vanadium oxide" for "vanadium" contradicts the contested decision, in which the above amendment was held to meet the requirements of both Rule 139 and Article 123(2) EPC.

Since the first auxiliary request remedies this deficiency in a simple manner, namely by deleting the alternative containing the deficiency, and since this amendment was filed one month before the oral proceedings, the board is of the opinion that the respondent had sufficient time to prepare its defence, and so the board exercises its discretion to admit this request into the proceedings.

3. First auxiliary request - Amendments

3.1 Claim 1 of this request differs from that of the main request in that the feature defining the SCR component as "*a solid acid of titanium dioxide and vanadium oxide*" has been deleted.

3.2 For the board, the amendment defining the catalyst (4) as "*not contain*[ing] *catalytically active platinum*

group metals" has the following basis in the application documents as originally filed:

3.2.1 The invention as claimed in claim 1 is defined as an exhaust gas treatment unit for the selective catalytic reduction of nitrogen oxides under lean exhaust gas conditions containing:

- at least catalytically active component for selective catalytic reduction (SCR components), and
- at least one storage component for nitrogen oxides (NOx components).

Claim 4 (dependent on claim 1) discloses the SCR components as containing at least one zeolite, which may be present in the acid H form or exchanged with metal ions;

Claim 5 (dependent on claims 1 to 4) discloses the NOx storage components as containing at least one compound of elements selected from the group consisting of alkali metals, alkaline earth metals and cerium.

Claim 6 (dependent on claim 5) discloses the NOx storage components to be catalysed with at least one of the platinum group metals platinum, palladium, rhodium and iridium.

3.2.2 As an alternative to such an exhaust gas treatment unit in which the NOx component is associated with at least one platinum group metal, the passage at page 4, lines 8 to 21, discloses "*an oxidation catalyst [...] located [...] upstream of the catalyst for selective catalytic reduction, which also oxidises nitrogen monoxide to nitrogen dioxide*". In a preferred embodiment, this alternative is described (page 4, lines 12 to 16) as

comprising **an oxidation catalyst upstream of a catalyst <u>according to the invention</u> of which the NOx storage components comprise no catalytically active platinum group metals**, with the oxidation of nitrogen monoxide to nitrogen dioxide solely occurring at the **upstream oxidation catalyst which may contain platinum on active alumina**.

3.2.3 Since in the application as filed, the catalyst "according to the invention" is the one defined in claim 1 as filed, i.e. a catalyst containing:

- at least catalytically active component for selective catalytic reduction (SCR components), **and**
- at least one storage component for nitrogen oxides (NOx components),

the above passage at page 4 is a direct and unambiguous disclosure in the application as filed of a catalyst as defined in claim 1 of the first auxiliary request.

3.2.4 Consequently, the board does not follow the respondent's argument that the application as filed described only the NOx storage component of the catalyst as not comprising catalytically active platinum metals.

3.3 Dependent claims 2 to 11 have their basis in the dependent claims of the application as filed (this has not been contested by the respondent). It follows from the above considerations that the claims of this request meet the requirements of Article 123(2) EPC.

4. First auxiliary request - Sufficiency of disclosure

The respondent argued that the patent failed to disclose how the basic NO_x storage component and the acidic SCR catalyst could be combined without being

neutralised and significantly reducing the activity of both components. This argument does not convince the board, since the skilled person knows how neutralisation can be avoided, namely by providing the NOx component in a non-alkaline form, for instance by using a nitrate salt thereof, or alternatively, by providing it as a solid, in which case an intimate contact between the components, and so an acid-base reaction, is minimised or avoided.

In the absence of evidence to the contrary, the invention is sufficiently disclosed, since the claimed exhaust gas treatment unit is easily manufacturable by a person skilled in the art, e.g. by mixing the defined compounds or their precursors and converting them into active catalysts according to commonly known procedures.

The patent is thus in conformity with the requirements of Article 83 EPC.

5. First auxiliary request - Novelty

5.1 Document D1 (claims 16 and 17) discloses a system for the treatment of exhaust gases comprising:

- a catalyst for oxidation of at least NO to NO_2;
- a filter for collecting soot and holding it for combustion with the NO_2 in the gas;
- a NO_x absorber containing a solid absorbent;
- means located downstream of the oxidation catalyst and upstream of the absorber for introducing intermittently a NO_x-specific reactant;
- a catalyst system located downstream the absorber to promote reactions of HC and CO with O_2 to H_2O and CO_2 and to react NO_x to N_2.

The system may be structured within a single housing or in separated housings (D1, page 2, lines 15 and 16) and the catalysts and absorbent are supported on a ceramic or metal honeycomb carrying a washcoat (page 2, lines 20 to 24).

The oxidation catalyst comprises generally a platinum group metal, especially platinum and/or palladium (page 2, lines 29 and 30).

The NOx absorbent may be selected from (a) compounds of alkali metals, alkaline earth metals, rare earth metals and transition metals and/or (b) adsorptive materials such as zeolites, carbons and high-area oxides (page 3, lines 17 to 27). Furthermore there may be present one or more catalytic agents, such as precious metals as reaction promoters (page 3, line 30 to page 5, line 2).

The NOx-specific reactant is preferably a nitrogen hydride, such as ammonia or hydrazine or their precursor, for example urea (page 4, lines 29 to 31).

In the examples, the NOx absorber consists of a monolith carrying a coating containing barium, platinum, rhodium and minor proportions of alumina, ceria and zirconia.

5.2 D1 fails to disclose the **combination** of an oxidation catalyst comprising platinum on active alumina with a platinum group metals-free catalyst containing at least one zeolite and at least one compound of elements selected from the group consisting of alkali metals, alkaline earth metals and cerium. The subject-matter of claim 1 is thus novel over D1.

5.3 As none of the other available documents discloses all the features of claim 1 at issue in combination (a fact which was not disputed by the respondent), it follows from the above considerations that claim 1 of this request, and by the same token claims 2 to 11, which depend on claim 1, meet the requirements of Article 54(1) and (2) EPC.

6. First auxiliary request - Inventive step

By applying the problem-solution approach, the board came to the conclusion that the subject-matter of claim 1 of this request involves an inventive step for the following reasons:

6.1 The invention relates to an exhaust gas treatment unit for the selective catalytic reduction of nitrogen oxides under lean exhaust gas conditions.

6.2 The closest state of the art is represented by document D1, the content of which is described in point 5.1 above. D1 discloses a catalytic unit for treating exhaust gases containing nitrogen oxides under lean exhaust gas conditions.

6.3 As to the problem underlying the contested patent, this is described at paragraph [0006] of the patent in suit as being to reduce the emission of nitrogen oxides from lean operated internal combustion engines even at exhaust gas temperatures below the light-off temperature for hydrolysis of urea and selective catalytic reduction.

6.4 As a solution to this problem, the contested patent proposes the exhaust gas treatment unit according to

claim 1 at issue, which is in particular characterised in that:

- the oxidation catalyst comprises platinum on active alumina; and

- the catalyst downstream of the point of injection of urea contains
  - at least one zeolite as an SCR component, and
  - at least one compound of elements selected from the group consisting of alkali metals, alkaline earth metals and cerium as a NOx storage component, and
  - it does not contain platinum group metals.

6.5 The question whether the problem identified in point 6.3 above is solved by the proposed solution is positively answered, since the compounds of alkali or alkaline metals and/or cerium are known to store the NOx at lower temperatures, and release NOx at higher temperatures for it to be converted by the SCR component, i.e. the zeolite, into harmless nitrogen.

6.6 However, as the exhaust gas treatment unit of D1 also makes use of a NOx absorber, the problem addressed in the patent in suit and defined under point 6.3 above has in fact already been solved. Therefore, the objective technical problem must be reformulated as the provision of an alternative exhaust gas treatment unit for the selective catalytic reduction of nitrogen oxides under lean exhaust gas conditions.

6.7 As to the question of obviousness, it has to be determined whether the proposed solution was obvious in the light of the state of the art, in particular in the

light of documents D6, D7 or D8, as argued by the respondent.

6.7.1 D6 (claims 1, 3, 4 and 10; Figure 1) discloses an exhaust gas treatment system for diesel engine exhaust comprising:

- a first upstream catalyst comprising platinum and γ-alumina as nitrogen oxide absorbent, with the exhaust gases being oxidised and the nitrogen oxides being absorbed at lower temperatures and released at higher temperatures;
- a second downstream catalyst comprising a lean-NOx catalyst or a selective reduction catalyst to convert the nitrogen oxides to nitrogen or nitrous oxide;
- an injection zone of a reductant (hydrocarbon, urea or ammonia) between the first and second catalysts.

According to paragraph [0026]:

(a) the lean-NOx catalyst uses a hydrocarbon for the reduction reaction of NOx and is exemplary Cu-ZSM-5, Fe-ZSM-5, Co-ZSM-5, or supported Rh;
(b) the SCR catalyst uses urea or ammonia and is exemplary a base metal zeolite, such as Cu-ZSM-5 or Ce mordenite.

For the board, the skilled person seeking an alternative to the exhaust gas treatment unit of document D1 and taking document D6 into consideration would not arrive at the subject-matter of claim 1 at issue, because D6 teaches to locate the NOx adsorbent upstream of the SCR catalyst, and not on the same catalyst, as in claim 1 at issue. Furthermore, D6 (paragraph [0017]) teaches away from using alkali or alkaline earth metal compounds as the NOx adsorbent.

6.7.2 D7 (claims 1 and 2) discloses an exhaust gas treatment system for lean-burn engines comprising in sequence:

- a catalyst for oxidising NO (in the examples this catalyst is platinum on stabilised alumina);
- an injection point for urea;
- a catalyst for hydrolysing urea into NH_3 and H_2O comprising a mixture of TiO_2, Al_2O_3, SiO_2, ZrO_2, Nb_2O_5, Ta_2O_5, WO_3 and/or a zeolite in the H form; and
- a reduction catalyst.

In the board's view, the skilled person would not arrive at the claimed invention in view of D7, because the latter does not teach to use on the same catalyst a zeolite and one compound of elements selected from the group consisting of alkali metals, alkaline earth metals and cerium to achieve a selective catalytic reduction of NOx.

6.7.3 D8 (claim 1, 7, 8 and 9) discloses a process for removing nitrogen oxides from an oxygen-containing gas by conversion to nitrogen and water, comprising a contacting step with an oxidation catalyst (preferably platinum and/or palladium), adding ammonia to the gas leaving this catalyst, and thereafter contacting said gas stream with a reduction catalyst. In preferred embodiments (claims 15, 17 or 19), the reduction catalyst is a mixture of at least two metal oxides, such as a mixture of titania and vanadia or a mixture of titania, vanadia, alumina and ceria.

D8 does not describe the use of a zeolite, let alone the combination of a zeolite with one compound of elements selected from the group consisting of alkali metals, alkaline earth metals and cerium, to achieve the selective reduction of NOx compounds, so the

skilled person faced with the problem of providing an alternative to the exhaust gas treatment unit of D1 would not arrive in an obvious manner at the wording of claim 1 at issue on the basis of the content of this document either.

6.7.4 The other documents in the proceedings also do not disclose or suggest the solution as defined in claim 1 at issue to the problem defined in point 6.3 above.

6.8 It follows from the above considerations that the subject-matter of claim 1 of the first auxiliary request involves an inventive step (Article 56 EPC).

The same applies to claims 2 to 11, which depend on claim 1 at issue.

7. Since the claims of the first auxiliary request meet the requirements of the EPC, there is no need to consider the lower-ranking 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 first auxiliary request as filed with letter dated 25 April 2016, and a description and drawings to be adapted thereto.

The Registrar: The Chairman:

C. Vodz H. Engl

Decision electronically authenticated