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Bezeichnung der Erfindung: Verfahren zur katalytischen Gasreinigung

Title of invention:

Titre de l'invention :

Klassifikation / Classification / Classement : B01D 53/36

ENTSCHEIDUNG / DECISION

vom / of / du 26 September 1989

Anmelder / Applicant / Demandeur :

Patentinhaber / Proprietor of the patent /
Titulaire du brevet :

Polska Akademia Nauk, Instytut Katalizy
i Fizykochemii Powierzchni

Einsprechender / Opponent / Opposant :

I. Fläkt AB
II. Linde AG

Stichwort / Headword / Référence :

EPO / EPC / CBE Article 56

Schlagwort / Keyword / Mot clé : "Inventive step (no)"

Leitsatz / Headnote / Sommaire

**Europäisches
Patentamt**

Beschwerdekammern

**European Patent
Office**

Boards of Appeal

**Office européen
des brevets**

Chambres de recours



Case Number : T 458/87 - 3.4.1

**DECISION
of the Technical Board of Appeal 3.4.1
of 26 September 1989**

Appellant :
(Proprietor of the patent) **Polska Akademia Nauk, Instytut Katalizy
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Respondent II :
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Decision under appeal : **Decision of the Opposition Division of the European
Patent Office dated 16 October 1987 revoking
European patent No. 0 037 119 pursuant to
Article 102(1) EPC**

Composition of the Board :

Chairman : H. Reich

Members : C. Black

C. Payraudeau

Summary of Facts and Submissions

- I. The Appellant is owner of European patent No. 0 037 119 (application number 81 102 411.6).
- II. The two Respondents having separately filed notices of opposition against this European patent, the Opposition Division revoked the patent on the ground that the granted claim lacks novelty with regard to document:
- D1: US-A-3 870 474.
- III. The Appellant (Patentee) lodged an appeal against the decision. Upon his request, the language of the proceedings was changed from German into English according to Rule 3(1) EPC.
- IV. In a communication of the Board accompanying the summons to oral proceedings the attention of the parties was among others drawn to the fact that a limitation of the generally claimed heat source to its embodiment in form of an electrical heater might not result in a claim on the basis of which the patent could be maintained, having regard to document D1 and document:
- D2: US-A-3 889 464.
- V. Thereupon the Appellant twice submitted a new claim, requesting that the patent be maintained in amended form.

The valid claim, which was filed on 20 September 1989, reads as follows:

"Verfahren zur katalytischen Gasreinigung industrieller Abgase in stationären Vorrichtungen mittels katalytischer

Konversion unerwünschter Bestandteile auf einem festen metallischen oder oxidischen Katalysator unter Einsatz einer Wärmequelle, wobei der zu reinigende Gasstrom einer reduzierenden oder einer oxidierenden katalytischen Umwandlung unterworfen wird, indem er einen Katalysator und vor und hinter dem Katalysator befindliche Schichten von metallischen oder keramischen Profilen periodisch in zwei verschiedenen Richtungen passiert, und die Profile in den Zeitintervallen zwischen den aufeinanderfolgenden Richtungsänderungen der Gasströmung durch den Reaktor die Wärme ansammeln, dadurch g e k e n n z e i c h n e t, dass der Gasstrom ein Katalysatorbett durchströmt und die Gasstromrichtung mit einer Häufigkeit von 1 bis 20 mal pro Stunde, vorzugsweise 10 bis 20 mal pro Stunde, gewechselt wird, wobei sich die zum Start und zur Aufrechterhaltung der katalytischen Konversionsreaktion notwendige Wärmequelle in Form eines elektrischen Heizkörpers im mittleren Teil des Katalysatorbettes befindet und vom Katalysator überschüttet ist."

- VI. Oral proceedings were held before the Board, at the end of which the Appellant (Patentee) maintained his request that the decision under appeal be set aside and that the patent be maintained on the basis of the claim arrived on 20 September 1989.

The Respondent "Linde AG" (Opponent) requested that the Appeal be dismissed.

The Respondent "Fläkt AB" (Opponent) being duly summoned, did not appear as announced beforehand.

- VII In support of his request the Appellant (Patentee) during oral proceedings handed over the following evidence:

E1: a diagram of the temperature profile in a device used in the claimed procedure along the direction of the reversing gas flow;

E2: Yu. Sh. Matros: "Unsteady Processes in Catalytic Reactors", Elsevier, Amsterdam et al., 1985, pages 311 and 350.

The Appellant essentially submitted the following arguments:

(a) The procedure known from document D1, Figure 6 and the corresponding description uses, instead of an electrical heater, a combustion zone wherein the heat source is in no direct contact with the catalyst material, and in particular does not disclose the use of a catalyst bed (such being defined as a space filled with a granular catalyst), document D1 indicating in column 6, lines 4 and 8 only that the catalyst is "in the warmest part of the regenerator" and is "part" of it and giving in the paragraph bridging pages 8 and 9 no hint to a granular form of the catalyst material. Thus, in order to arrive from the state of the art known from document D1 at the claimed method, a skilled person would have:

1. to replace combustion zone 48 by an electric heater,
2. to provide separate from the heat accumulating regenerator material a space containing only catalyst granules; i.e. a catalyst bed, and
3. to bring the electric heater in direct contact with the catalyst granules.

- (b) Document D2 gives no indication to heat a catalyst bed electrically, because in this known device the catalyst material is either in form of a coating on the surface an electrically conducting wire or has a honeycomb structure. Moreover, a skilled person would have a prejudice to bring catalyst granules into direct contact with the surface of an electrical heater fearing detrimental effects. In order to avoid catalyst poisoning by combustion products a skilled person would use a better fuel, electricity being normally too expensive. Though the patent under appeal mentions other heat sources, all disclosed examples and the embodiment shown in the drawing use an electrical heater.
- (c) In view of the decisions T 9/86, OJ EPO 1988, 12, and T 37/85, OJ EPO 1988, 86, the use of electrical heating known from document D2 in the method known from document D1 would have to be regarded as implying an inventive step.
- (d) The claimed method would lead to a low energy consumption due to the resulting compact device structure and allow an easy replacement of a deactivated catalyst bed.
- (e) A skilled person would not expect that the claimed measures result in the creation of a maximum in the temperature profile of the catalyst bed and in a shifting of this maximum between two decentered positions, such as shown in evidence E1. In the method according to document D1, the temperature decreases always linearly on both sides of the combustion zone, oscillating between higher and lower values.

(f) Thus, in the claimed invention, but not in document D1, a so-called "enforced unsteady state" of a heterogenous catalyst would be realised, which - at the priority date of the patent under appeal - was not known to increase the efficiency and selectivity of a catalyst, such as indicated in evidence E2. Moreover, the prolongation of the lifetime of the catalyst bed would be surprising. A device incorporating the claimed method has worked efficiently already for seven years without any need to change the catalyst bed and a guarantee of four years is given to sold devices.

VIII. These arguments were contested by the Respondent "Linde AG" (Opponent), who essentially submitted the following:

(a) Document D1 mentions in column 9, lines 1 and 2, expressly "alumina balls impregnated with copper", i.e. a catalyst in granular form, and in column 6, lines 4 and 5, a "horizontal layer" of a catalyst, i.e. a catalyst filled space. Thus, a catalyst bed according to the definition given by the Appellant himself would be known from document D1. For this reason, only one step would be necessary in order to arrive from the known method at the claim: the replacement of the combustion zone by an electrical heater. A skilled person would be aware of the fact that the gap in the middle of the catalyst bed in Figure 6 of document D1 is necessary because of the gas heating via an open flame. Replacing heating of the catalyst using a hot gas by an electrical heater, a skilled person would automatically and inevitably provide a direct contact between the heater surface and the catalyst material in order to allow the heat to be transferred from granule to granule.

- (b) Due to the fact that it is generally known to use an electrical heater in the experimental stage of developing new catalysts, even document D2 would not be necessary to show that electrical catalyst activation belongs to the state of the art. Nothing inventive could be seen in applying it to a granular catalyst bed, being the most usual form of a catalyst material in the stationary devices of chemical industry. In document D1, electrical heating would not be mentioned because it is too expensive. Thus, the obstacle would be of economical and not of technical nature. Catalyst producers indicating the allowable and most efficient temperature range to be applied to their product, a skilled person would have no difficulties in avoiding any detrimental effect in a catalyst granule, which directly contacts the surface of an electrical heater.
- (c) The patent under appeal discloses electricity as one of a group of equivalent heating means, including also combustion; see column 3, lines 47-52. None of the effects or advantages adduced by the Appellant in points VII (d), (e) and (f) above are disclosed in the specification or original application documents of the patent under appeal. From its description, column 4, lines 7-13, it follows that also no preference is given to the granular form of a catalyst. The patent under appeal discloses, moreover, no opening for replacing the catalyst bed.
- (d) In evidence E2, the "enforced unsteady state" is defined as the cyclic change of the local catalyst temperature. Thus, it is present in any regenerator system as a direct consequence of the reversing gas flow, in particular in the method known from document D1.

(e) The Appellant did neither present explicit values of all parameters which influence the effects mentioned in points VII (d), (e) and (f) above nor did he demonstrate the alleged low energy consumption and the higher efficiency, selectivity and lifetime of the catalyst by a comparative test. Therefore, these arguments should be regarded as unsupported statements, which are not filed in due time, being produced for the first time in the oral proceedings and giving the Respondent no possibility to verify them by counter-tests.

Reasons for the Decision

1. The appeal is admissible.
2. Novelty.
 - 2.1 From document D1 there is known, according to the wording of the claim, a

"Verfahren zur katalytischen Gasreinigung industrieller Abgase in stationären Vorrichtungen (column 1, lines 11-22 and Figure 6) mittels katalytischer Konversion unerwünschter Bestandteile auf einem festen metallischen oder oxidischen Katalysator (column 7, lines 17-23) unter Einsatz einer Wärmequelle (48 in Figure 6), wobei der zu reinigende Gasstrom einer reduzierenden oder einer oxidierenden katalytischen Umwandlung unterworfen wird (column 7, lines 17-22 in combination with 49-55), indem er einen Katalysator und vor und hinter dem Katalysator befindliche Schichten von metallischen oder keramischen Profilen (column 6, lines 2-12) periodisch in zwei verschiedenen Richtungen passiert (column 6, lines 59-62),

und die Profile in den Zeitintervallen zwischen den aufeinanderfolgenden Richtungsänderungen der Gasströmung durch den Reaktor die Wärme ansammeln (column 2, lines 34-41), dadurch gekennzeichnet, daß der Gasstrom ein Katalysatorbett durchströmt (column 6, lines 7-9 in combination with column 8, line 65 to column 9, line 2), wobei sich die zum Start und zur Aufrechterhaltung der katalytischen Konversionsreaktion notwendige Wärmequelle (48) im mittleren Teil des Katalysatorbettes befindet (see 49 and 50 in Figure 6)".

A catalyst "layer" (D1, column 6, line 9) has to be regarded as a space filled with catalyst material, and a catalyst material in form of a "ball" (D1, column 9, line 1) as granular; see also point VIII-a. For these reasons, the Board is convinced that - contrary to the Appellant's view in point VII-a - document D1 discloses clearly an alternative embodiment in form of a catalyst bed.

Thus, the subject-matter of the claim differs from the method according to document D1 in that:

- (a) "die Gasstromrichtung mit einer Häufigkeit von 1 bis 20 mal pro Stunde, vorzugsweise 10 bis 20 mal pro Stunde, gewechselt wird";
- (b) the heat source is provided "in Form eines elektrischen Heizkörpers"; and
- (c) the heat source in form of an electrical heater is "vom Katalysator überschüttet."

2.2 In the catalytic purification method known from document D2, the electrical heater (318, 405) heats no granular catalyst bed but a catalyst in form of an overcoat on the

heating wire (column 5, lines 36-38) or a separate honeycomb structure (401). Moreover, the gas flow is not reversed.

2.3 The remaining documents on file do not come closer to the subject-matter of the claim.

2.4 For the above reasons, the subject-matter of the claim is considered to be novel within the meaning of Article 54 EPC.

3. Inventive step.

3.1 Starting from the nearest prior art as disclosed in document D1, the objective problem underlying the present invention as claimed in the claim is to create an efficient catalytic purification method which allows to maintain the optimal exploitation of the heat from the hot reaction gas when applying one of the other known alternative energy forms for catalyst activation; see also the patent under appeal, column 2, lines 45-53, and column 3, lines 47-52.

3.2 In the Board's view, the necessity to deviate from combustion for activating a catalyst may well arise from practical needs and purposes. Efficiency and retention of known advantages combined with the use of an alternative form of energy are regarded as normal routine tasks. Therefore, no positive contribution to inventive step can be seen in formulating the technical problem.

3.3 This problem is solved by the distinguishing measures (a), (b) and (c) already mentioned in point 2.1 above, i.e. in that:

- (a) the gas flow direction is reversed at a frequency of 1 to 20 times per hour, preferably 10 to 20 times per hour;
- (b) the heat source has the form of an electrical heater; and
- (c) is covered by the catalyst.

3.4 In the Board's view, a skilled person arrives at the dimensioning rule according to distinguishing feature (a) by simple trial and error in view of his specific needs.

3.5 The Appellant has not contested the fact, that it is known - in particular from document D2 - to activate a catalyst material by direct contact to an electrical heater; see point VII-b above.

The expert for catalytic purification of industrial waste (i.e. the field of the alleged invention and document D1) is held by the Board to normally watch the development in the neighbouring field of purification of exhaust gases from internal combustion engines (i.e. the field of document D2). Thus, the competent expert can be regarded as knowing that a catalyst may be activated by means of an electrical heater. It is a generally accepted principle in judging on inventive step that a skilled person, who employs the best means already available for his purposes, only contributes to the normal progress of technology and must be free to do so. Therefore, it is to be regarded as obvious for the skilled person to make use of the known advantageous effects of electrical heating for catalyst activation according to document D2 -for instance, no poisoning of the catalyst by combustion products - also in the method known from document D1.

In the opinion of the Board, a skilled person is able to recognise that - when using an electrical heater surface contacting directly catalyst granules - it is necessary to keep the heating surface below the given desactivation temperature of the catalyst. The Appellant's opinion in point VII-b above is held to be an unsupported view of a single person, which cannot be accorded general validity. In order to be able to reasonably rely on a prejudice which might have diverted the skilled man away from the alleged invention, it would have been necessary for the Appellant to establish that a real prejudice existed against activation of catalyst granules by means of an electrical heater, which prejudice was generally spread and well accepted in the art; see also T 19/81, OJ EPO, 1982, 51.

For the above reasons, nothing inventive can be seen in distinguishing feature (b).

- 3.6 Using combustion, energy is made available in form of a hot gas. Using an electrical heater, however, energy is made available in form of a solid surface. A skilled person is regarded as knowing that an energy transfer to the catalyst material only via waste gas, which is heated by the hot surface of the electrical heater, would be very slow. In electrical heating the usual and known technology is to use for energy transfer the thermal conductivity of the material to be heated by contacting it directly. Thus, when a skilled man uses for heating both the waste gas flow and the thermal conductivity of the catalyst material, and for this purpose "covers the electrical heat source with catalyst" according to distinguishing feature (c), he only applies his general basic knowledge. For this reason, distinguishing feature (c), in the Board's view, represents a routine adaptation measure within the obvious use of catalyst activation by means of an electrical

heater, i.e. a measure which lies within the normal capacities of a skilled person.

3.7 The decision T 37/85 mentioned by the Appellant in point VII-c does not apply to the present use of a known technology in a closely related situation, but to a combination invention. However, an unexpected combination effect, surpassing the sum of the known effects produced by reversing the gas flow and by heating electrically has not been put forward. Furthermore, the simplicity of the proposed solution, as an indication of inventive step, put forward by the Appellant by citing decision T 9/86, does not exclude the prerequisite that the solution per se must be non-obvious to a skilled person.

3.8.1 Contrary to the Appellant's view expressed in point VII-d above, the Board is convinced that a skilled person will expect the temperature profile within the catalyst bed of the alleged invention to have a maximum because of the central location of the electrical heater within the catalyst bed and the spreading of the energy into the neighbouring three-dimensional space of the bed, which spreading lowers the energy density. Furthermore, according to the generally known laws of heat transfer, it is to be expected that a laterally moving gas flow first cools down the hottest catalyst region in the centre and then warms up the remote cooler parts. For these reasons also the shifting of the temperature maximum demonstrated in evidence E1 is regarded to be foreseeable by an expert.

3.8.2 In order to demonstrate an inventive step, a surprising effect must be shown to have its origin in the technical features distinguishing an invention from its closest

prior art; see also the decision T 192/82, OJ EPO 1984, 415. However, contrary to the Appellant's view in point VII-e, evidence E2 does not teach that the efficiency and productivity of a catalyst can be increased by placing an electrical heater into a catalyst bed, but indicates explicitly that these advantages can be achieved by an appropriate modification of the "composition and structure" of the catalyst, see E2, page 350, lines 10-12. Even a statement that said advantages were a technical consequence of the unsteady state itself would not prove that the adduced advantages have their origin in the electric form of catalyst activation. For it follows from evidence E2, page 311, last paragraph and page 350, paragraph 1, that the so-called "unsteady state" of a catalyst results from its cyclically changing temperature (see in particular page 311, last paragraph and page 350, paragraph 1) which can be realised by a variety of methods, including the use of a reversing gas flow. Hence, an "unsteady state" of catalyst is also realised in document D1.

- 3.8.3 The Appellant's argument in point VII-e above, concerning a longer catalyst lifetime, has to be considered as an allegation being neither technically explained nor evidenced by a comparative test.
- 3.8.4 In point VII-f above, the Appellant himself explained the lower energy consumption by a more compact device structure. Due to the fact that the device geometry does not belong to the subject-matter of the claim, this advantage cannot be taken into consideration. The easy exchange of catalyst material mentioned in point VII-f above can - within the frame of the original disclosure - only be ascribed to the use of a granular catalyst bed and is therefore already realised in the state of the art according to document D1.

- 3.8.5 As set out in points 3.8.1 to 3.8.4 above, none of the properties and effects, which have been brought forward by the Appellant during oral proceedings, is held to be indicative of an inventive step underlying the subject-matter of the claim. Therefore, the Board was able to decide upon the case without giving the Respondent the possibility for a counter-test; see point VIII-e.
- 3.9 For the reasons indicated in detail in points 3.1 to 3.8.5 above, the subject-matter of the claim is held to be the use of a known technology in a closely analogous situation, accompanied by an adaptation measure and dimensioning rule which both fall within the normal skill of the expert. Therefore, the claim is considered to lack an inventive step within the meaning of Article 56 EPC.
4. Thus, the claim does not meet the requirements of Article 52(1) EPC and for this reason cannot form the basis of a patent maintained in amended form according to Article 102(3) EPC.

Zc, 17. 10. 89

Order

For these reasons, it is decided that:

The Appeal is dismissed.

The Registrar:



M. Beer

03689

The Chairman:



H. Reich

BB 18.10.89
Cr