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D E C I S I O N
of 22 January 2004

Case Number: T 0049/02 - 3.2.4

Application Number: 94904326.9

Publication Number: 0636770

IPC: F01N 3/24

Language of the proceedings: EN

Title of invention:

Exhaust gas cleaning device for an internal combustion engine

Patentee:

TOYOTA JIDOSHA KABUSHIKI KASHIHA

Opponents:

PEUGEOT CITROEN AUTOMOBILES
Ford Global Technologies, Inc.

Headword:

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Relevant legal provisions:

EPC Art. 54, 56, 87

Keyword:

"Priority right of the claimed invention - no"
"Novelty - yes"
"Inventive step - yes"

Decisions cited:

G 0002/98

Catchword:

-



Case Number: T 0049/02 - 3.2.4

D E C I S I O N
of the Technical Board of Appeal 3.2.4
of 22 January 2004

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Decision under appeal: Interlocutory decision of the Opposition
Division of the European Patent Office posted
16 November 2001 concerning maintenance of
European patent No. 0636770 in amended form.

Composition of the Board:

Chairman: C. A. J. Andries
Members: T. Kriner
H. Preglau

Summary of Facts and Submissions

I. The appellant I (patent proprietor) lodged an appeal, received at the EPO on 2 January 2002, against the interlocutory decision of the opposition division posted on 16 November 2001 on the amended form in which the European patent No. 0 636 770 could be maintained. The appeal fee was paid simultaneously and the statement setting out the grounds of appeal was received at the EPO on 6 March 2002.

Likewise, both the appellant II (opponent I) and the now party as of right (opponent II) lodged an appeal, received at the EPO on 24 January 2002 (appellant II) and 21 January 2002 (party as of right) against the interlocutory decision of the opposition division. The fees for these appeals were paid simultaneously and the statements setting out the grounds of appeal were received at the EPO on 18 March 2002 (appellant II) and on 30 January 2002 (party as of right).

With the letter of 20 November 2003, the now party as of right withdrew both its opposition and its appeal.

II. Opposition was filed against the patent as a whole and based on Article 100(a) EPC in conjunction with Articles 52(1), 54(1), 56 EPC, on Article 100(b) EPC in conjunction with Article 83 EPC, and on Article 100(c) EPC in conjunction with Article 123(2) EPC.

In its decision the Opposition Division held that

- the subject-matter of claim 1 as granted was not new with respect to the state of the art as represented by

FD1: EP-A-0 585 900;

- the subject-matter of claim 12 of the first auxiliary request then on file did not involve an inventive step with respect to

PD1: AU-B-26850/92 and

FD4: SAE Paper 800019;

- the subject-matter of the auxiliary request II then on file met the requirements of the EPC.

III. Oral proceedings took place on 22 January 2004.

The appellant I requested that the decision under appeal be set aside and that the patent be maintained as granted (main request) or on the basis of the auxiliary requests 1 to 4 filed with the letter of 19 December 2003.

The appellant II requested that the decision under appeal be set aside and that the patent be revoked.

IV. Claim 1 as granted (main request) reads as follows:

"An exhaust purification device of an internal combustion engine in which an NO_x absorber which absorbs NO_x when the air-fuel ratio of an inflowing exhaust gas is lean and releases the absorbed NO_x when the air-fuel

ratio of the inflowing exhaust gas is the stoichiometric air-fuel ratio or rich is arranged in an engine exhaust passage, an air-fuel ratio sensor is arranged in the engine exhaust passage downstream of said NO_x absorber, and NO_x releasing completion decision means is provided for deciding that the releasing action of NO_x from the NO_x absorber is completed when the air-fuel ratio detected by the air-fuel ratio sensor is switched from lean to the stoichiometric air-fuel ratio or rich after the air-fuel ratio of the exhaust gas flowing into the NO_x absorber is switched from lean to the stoichiometric air-fuel ratio or rich and the releasing action of NO_x from the NO_x absorber is started."

- V. In support of his main request the appellant I relied essentially on the following submissions:

Claim 1 as granted included all essential features of the invention disclosed in the first priority document (Japanese patent application JP 6746/93) of the patent in suit. The feature according to which the air-fuel ratio of the exhaust gas flowing into the NO_x absorber was returned to lean when the air-fuel ratio detected by the air-fuel ratio sensor was switched from lean to the stoichiometric air-fuel ratio or rich after the air-fuel ratio of the exhaust gas flowing into the NO_x absorber was switched from lean to the stoichiometric air-fuel ratio or rich to release the NO_x from the NO_x absorber, was not an essential feature. Moreover this feature was implicitly included in claim 1 as granted, since it was obvious from the whole content of this claim that it was intended to operate the claimed combustion engine normally at a lean air-fuel ratio.

The subject-matter of claim 1 as granted was novel. The sensor arranged in the exhaust passage downstream of the NO_x absorber shown in FD1 was not an air-fuel ratio sensor, but a HC concentration sensor. Furthermore, the NO_x releasing completion decision means according to FD1 did not decide that the releasing action was completed when the air-fuel ratio detected by this sensor was switched from lean to the stoichiometric air-fuel ratio or rich, but when the HC concentration exceeded a predetermined value. Hence FD1 did not disclose all features of claim 1 as granted.

The subject-matter of claim 1 as granted did also involve an inventive step. Starting from the state of the art disclosed in PD1, the object underlying the patent in suit was to provide an exhaust gas purification device which could detect when the NO_x releasing action from the NO_x absorber had been completed. In accordance with claim 1 as granted, this object was achieved by the provision of an air-fuel ratio sensor and a NO_x releasing completion decision means which decided on the basis of a signal from the sensor when the NO_x releasing action from the NO_x absorber was completed. Since the state of the art did not suggest such means, their provision in the device according to PD1 could not be regarded as obvious. FD4 referred to the application of exhaust-gas-oxygen sensors to the study of storage effects in automotive three-way catalysts which were not NO_x absorbers as described in the patent in suit. Therefore the skilled person dealing with the object underlying the patent in suit had no reason to consider this document. Moreover, even if he considered this document, it could not lead

him to the subject-matter of claim 1 as granted, since it did not refer to the determination of the completion of the NO_x releasing action of a NO_x absorbent.

VI. The appellant II disputed the views of the appellant I with arguments which can be summarized as follows:

The first priority document (Japanese patent application JP 6746/93) of the patent in suit exclusively disclosed an exhaust purification device wherein the air-fuel ratio of the exhaust gas flowing into the NO_x absorber was returned to lean when the air-fuel ratio detected by the air-fuel ratio sensor changed from lean to the stoichiometric air-fuel ratio or rich after the air-fuel ratio of the exhaust gas flowing into the NO_x absorber was switched from lean to the stoichiometric air-fuel ratio or rich to release the NO_x from the NO_x absorber. This embodiment clearly excluded any generalisation which did not require that the NO_x absorber was returned to lean when the end of regeneration of the NO_x absorber had been detected. Since claim 1 as granted did not include such a requirement, it was not entitled to the priority of the first priority document of the patent in suit.

FD1 disclosed an exhaust purification system having all features of claim 1 as granted. The sensor (23) shown in Figure 16 of this document was not explicitly defined as an air-fuel ratio sensor. However, since this sensor detected the HC concentration which like the oxygen concentration was dependent on the air-fuel ratio, it obviously functioned and qualified as an air-fuel sensor. The feature of the granted claim 1 of the patent in suit, according to which the NO_x releasing

completion decision means decided that the NO_x releasing action had been completed **when** the air-fuel ratio detected by the air-fuel ratio sensor was switched from lean to rich, had to be interpreted in such a way that this decision was taken **if** the detected air-fuel ratio was switched from lean to rich. Since the NO_x releasing completion decision means according to FD1 likewise decided that the NO_x releasing action had been completed if the concentration of the unburned HC in the exhaust gas flowing from the NO_x absorber became high, i.e. if it became larger than a predetermined value , the NO_x releasing completion decision means defined in the granted claim 1 of the patent in suit and in FD1 were the same. Therefore, the subject-matter of claim 1 as granted lacked novelty.

If the subject-matter of this claim should be considered as novel, it was at least not based on an inventive step. PD1 disclosed an exhaust purification device which differed from the device according to the granted claim 1 of the patent in suit only in that it did not comprise an air-fuel ratio sensor which was used for deciding when the releasing action of NO_x from the NO_x absorber was completed. Since the skilled person knew that the performance of a catalyst was dependent on an aging process, the technical problem underlying the subject-matter of the patent in suit could be regarded as to consider the aging effect of the NO_x absorber for the NO_x releasing action. Since FD4 showed that an air-fuel ratio sensor could be used for the consideration of the aging effect of a catalyst, the use of an air-fuel ratio sensor in the device according to PD1 in such a way that the completion of the NO_x

releasing action was decided on the basis of the signal of this sensor, was obvious.

Reasons for the Decision

1. The appeal is admissible.

2. *Priority*

2.1 In accordance with G 2/98 (OJ EPO 2001, 413) the priority of a previous application in respect of a claim in a European patent application, and consequently also in respect of a claim in a European patent, in accordance with Article 87 EPC is to be acknowledged only if the skilled person can derive the subject-matter of the claim directly and unambiguously, using common general knowledge, from the previous application as a whole.

In the present case, the question arises whether or not the skilled person can derive the subject-matter of claim 1 as granted (main request) from the first priority document (Japanese patent application JP 6746/93) cited in the patent in suit; in particular, whether or not he can derive from this priority document an exhaust purification device according to the granted claim 1.

2.2 The first priority document exclusively refers to an exhaust purification device wherein the air-fuel ratio of the exhaust gas flowing into the NO_x absorber is returned to lean once again when the air-fuel ratio detected by the air-fuel ratio sensor changes from lean

to the stoichiometric air-fuel ratio or rich after the air-fuel ratio of the exhaust gas flowing into the NO_x absorber is switched from lean to the stoichiometric air-fuel ratio or rich to release the NO_x from the NO_x absorber (see translation of the Japanese patent application JP 6746/93 filed by the appellant I with the letter of 11 October 1994, for example claim 1; page 3, section 0005; page 4, section 0006; page 14, section 0021; pages 15 and 16, section 0023).

In comparison with the first priority document, claim 1 as granted does not require that the air-fuel ratio of the exhaust gas flowing into the NO_x absorber is returned to lean once again when the regeneration of the NO_x absorber is completed. Therefore, the subject-matter of claim 1 as granted extends beyond the disclosure of the first priority document in such a way that the skilled person cannot derive the subject-matter of the claim directly and unambiguously from this document.

- 2.3 The argumentation of the appellant I according to which the skilled person could derive the subject-matter of claim 1 as granted from the first priority document is not convincing.

With respect to the issue of acknowledgement of the first priority right, it does not matter in the present case whether or not the feature according to which the air-fuel ratio of the exhaust gas flowing into the NO_x absorber was returned to lean once again when the completion of the regeneration of the NO_x absorber was detected, is an essential feature of the claimed invention. In the light of G 2/98, the only question to

be answered is whether or not the first priority document discloses an exhaust purification device, wherein the air-fuel ratio of the exhaust gas flowing into the NO_x absorber is not returned to lean after the completion of the regeneration of the NO_x absorber is detected. Since this is not the case, the omission of the feature relating to the return to a lean air-fuel ratio of the exhaust gas results in a generalisation and consequently in an extension of the disclosure of the first priority document.

Furthermore the Board does not agree with the appellant I's statement that the feature in question was implicitly included in claim 1 as granted. This claim refers to an exhaust purification device of an internal combustion engine, the use of which is not defined. It does not include any indication that this engine is a lean burn combustion engine which normally operates at a lean air-fuel ratio. Consequently there is no reason to assume that the air-fuel ratio of the exhaust gas flowing into the NO_x absorber is necessarily returned to lean after the completion of the regeneration of the NO_x absorber.

Moreover, if - as stated by the appellant I - that feature was implicitly included in claim 1, the board does not understand why that feature has not been explicitly brought into claim 1.

2.4 Consequently claim 1 as granted is not entitled to the claimed first priority right of the Japanese patent application JP 6746/93.

As a result of this finding, PD1 forms part of the state of the art according to Article 54(2) EPC.

3. *Novelty*

3.1 Novelty of the subject-matter of claim 1 as granted (main request) has been challenged exclusively with respect to FD1 which forms part of the state of the art for all designated contracting states of the patent in suit in accordance with Article 54(3) and (4) EPC.

This document discloses (see in particular Figures 16, 17(A), 17(B) and the corresponding description in column 17, line 28 to column 20, line 10) an exhaust purification device of an internal combustion engine (1) in which a NO_x absorber (18) which absorbs NO_x when the air-fuel ratio of an inflowing exhaust gas is lean and releases the absorbed NO_x when the air-fuel ratio of the inflowing exhaust gas is the stoichiometric air-fuel ratio or rich is arranged in an engine exhaust passage (17, 22), a sensor (23) is arranged in the engine exhaust passage downstream of said NO_x absorber, and NO_x releasing completion decision means is provided for deciding on the basis of the value of the variable sensed by the sensor that the releasing action of NO_x from the NO_x absorber is completed after the air-fuel ratio of the exhaust gas flowing into the NO_x absorber is switched from lean to the stoichiometric air-fuel ratio or rich and the releasing action of NO_x from the NO_x absorber is started.

However, FD1 does not disclose

(a) that the sensor is an air-fuel ratio sensor, and

(b) that the NO_x releasing completion decision means decides that the releasing action of NO_x from the NO_x absorber is completed when the air-fuel ratio detected by the air-fuel ratio sensor is switched from lean to the stoichiometric air-fuel ratio or rich.

3.2 The argumentation of the appellant II according to which these features are also disclosed in FD1 is not convincing.

The sensor (23) disclosed in FD1 is a HC concentration sensor, and the NO_x releasing completion decision means decides that the releasing action of NO_x from the NO_x absorber is completed when the HC concentration detected by this sensor exceeds a predetermined value (see column 17, lines 29 to 33, and column 18, lines 13 to 21). This value, although being a "predetermined" value, has to be considered as a value which can be selected from a broad range.

In accordance with the whole disclosure of the patent in suit however, the NO_x releasing completion decision means decides that the releasing action of NO_x from the NO_x absorber is completed **substantially at that moment** when the air-fuel ratio detected by the NO_x sensor arranged downstream of the NO_x absorber is switched from lean to the stoichiometric air-fuel ratio or rich (see for example Figures 7 to 11, 20, 26 to 28 and the corresponding description). Therefore, the board does not share the appellant II's opinion that claim 1 as granted may be interpreted in such a way that the NO_x releasing completion decision means decides that the

releasing action of NO_x from the NO_x absorber is completed, if (instead of when) the air-fuel ratio detected by the NO_x sensor is switched from lean to rich, or in other words not at the moment of switching from lean to rich, but at any time after the switching from lean to rich. The decision at substantially the moment of switching from a lean to a stoichiometric or rich air-fuel ratio as suggested by the patent in suit requires a sensor which delivers a clear signal when this moment has come, such as an air-fuel ratio sensor working on the basis of the oxygen concentration in the exhaust gas (see patent in suit, column 9, line 55 to column 11, line 50). By comparison with this air-fuel sensor, the HC concentration sensor according to FD1 does not enable a clear determination of the moment when the air-fuel ratio switches from lean to rich. This is not possible, since the HC concentration does not change very much around the stoichiometric air-fuel ratio (see for example Figure 4 of FD1). For this reason the NO_x releasing completion decision means according to FD1 can only decide that the releasing action is completed at a moment when the detected HC concentration becomes high (see column 17, line 56 to column 18, line 3), ie that the air-fuel ratio of the exhaust gas is already clearly rich. Therefore, even if the HC concentration sensor according to FD1 is regarded as an air-fuel ratio sensor, FD1 does not disclose the feature b) mentioned in section 3.1 above, particularly since the broad range from which the value may be selected cannot destroy the novelty of a specifically defined value, ie the moment of switching.

With respect to the argumentation of the opposition division, the board wants to emphasize that in the framework of the novelty assessment only unequivocally and clearly defined features of the anticipation may be considered, not possible features. If, as in the present case, the anticipation does not disclose and even does not suggest to consider the HC-sensor output value together with its slope for defining (be it with software or be it with hardware) the air-fuel value of the mixture used in the internal combustion engine (see decision of the opposition division, page 4, last paragraph), such a possible use of the HC-sensor output cannot be considered for the novelty assessment.

3.3 With respect to the above findings, the subject-matter of claim 1 as granted (main request) is novel.

4. *Inventive step*

4.1 As agreed by both parties, the closest pre-published prior art is represented by PD1. With respect to claim 1 as granted, this document discloses an exhaust purification device of an internal combustion engine (1) in which a NO_x absorber (18) which absorbs NO_x when the air-fuel ratio of an inflowing exhaust gas is lean and releases the absorbed NO_x when the air-fuel ratio of the inflowing exhaust gas is the stoichiometric air-fuel ratio or rich is arranged in an engine exhaust passage (17).

Furthermore the device according to PD1 comprises a NO_x releasing completion decision means for deciding that the releasing action of NO_x from the NO_x absorber is

completed when a fixed time has elapsed (see Figure 8, step 109; page 14, lines 27 to 34).

Therefore the subject-matter of claim 1 as granted differs from the device according to PD1 by the provision of

- an air-fuel ratio sensor arranged in the engine exhaust passage downstream of said NO_x absorber, and
- NO_x releasing completion decision means for deciding that the releasing action of NO_x from the NO_x absorber is completed when the air-fuel ratio detected by the air-fuel ratio sensor is switched from lean to the stoichiometric air-fuel ratio or rich after the air-fuel ratio of the exhaust gas flowing into the NO_x absorber is switched from lean to the stoichiometric air-fuel ratio or rich and the releasing action of NO_x from the NO_x absorber is started.

4.2 With respect to the case law of the boards of appeal of the EPO, an objective definition of the problem to be solved by an invention should normally start from the problem described in the patent in suit. Only if an examination shows that the problem has not been solved or if an inappropriate prior art has been used to define the problem, it has to be investigated which other problem objectively existed (see Case Law of the Boards of Appeal, 2001, 4th edition, I.D.4.3, English version, page 107).

In the present case the problem to be solved is described in the patent in suit as to provide an exhaust gas purification device which can detect when the NO_x releasing action from the NO_x absorber has been completed (see column 2, lines 29 to 32). Since this problem is obviously solved by the subject-matter of claim 1 as granted, in particular by the provision of the air-fuel ratio sensor and the NO_x releasing completion decision means, and since no inappropriate prior art has been used to define this problem, there is no reason to consider any other problem (including the problem mentioned by the appellant II) within the problem-solution approach for the assessment of inventive step.

- 4.3 The provision of the air-fuel ratio sensor and the NO_x releasing completion decision means as defined in claim 1 as granted in an exhaust purification device according to PD1 to solve the problem underlying the patent in suit is not suggested by the available state of the art.

FD4 refers to the application of exhaust gas oxygen sensors (EGO sensors) to the study of storage effects in automotive three-way catalysts. The sensors were arranged upstream and downstream of a three-way catalyst, to observe the times when step-function changes applied to the inlet exhaust flow become evident in the outlet exhaust flow (see page 14, right hand column, "Features of the Experimental Technique Reported Here"). Since FD4 does not deal with the problem of detecting the completion of a NO_x releasing action from a NO_x absorber, this document cannot even suggest the arrangement of an air-fuel ratio sensor

downstream of a NO_x absorber for detecting a change in the air-fuel ratio of the exhaust gas released from the NO_x absorber as a result of the state of the NO_x absorber, let alone the provision of NO_x releasing completion decision means for deciding that the releasing action of NO_x from the NO_x absorber is completed on the basis of the air-fuel ratio detected by such an air-fuel ratio sensor.

- 4.4 Even if the problem to be solved by the patent in suit were to be regarded as being to consider the aging effect of the NO_x absorber on the NO_x releasing action, and the skilled person considered FD4 for the solution of this problem, as submitted by the appellant II, this could not lead him in an obvious way to the exhaust purification device according to claim 1 as granted. FD4 discloses the use of two air-fuel ratio sensors for studying the response of such a catalyst to fast changes in the air-fuel ratio of the exhaust gas. It is true that it has been shown amongst other things that these responses are depending on the age of the catalyst. However, this finding cannot be regarded as a suggestion to provide an air-fuel ratio sensor downstream of a NO_x absorber for delivering a signal, on the basis of which it can be decided when a releasing action of NO_x from the absorber is completed, in order to consider the aging process of the NO_x absorber on the completion of the releasing action. FD4 could at best suggest the use of two air-fuel ratio sensors, one upstream and one downstream of a catalyst for detecting the aging of the catalyst, but not the provision of a NO_x releasing completion decision means which considers the aging effect.

4.5 With respect to the above findings, the board comes to the conclusion that the subject-matter of claim 1 as granted (main request) also involves an inventive step.

5. Since the patent in suit can therefore be maintained as granted, i.e. on the basis of the appellant I's main request, there was no reason to consider his auxiliary requests.

Order

For these reasons it is decided that:

1. The decision under appeal is set aside.
2. The patent is maintained unamended.

The Registrar:

The Chairman:

G. Magouliotis

C. Andries