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**Datasheet for the decision
of 6 November 2014**

Case Number: T 0857/12 - 3.3.05

Application Number: 09157393.1

Publication Number: 2123599

IPC: C01B3/38, B01J8/02, B01J8/04

Language of the proceedings: EN

Title of invention:
Fuel reformer

Applicant:
Precision Combustion, Inc.
Honda Motor Co., Ltd.

Headword:
REFORMER/HONDA

Relevant legal provisions:
EPC Art. 84, 111(1), 123(2)

Keyword:
Claims - clarity after amendment (yes)
Amendments - added subject-matter (no)
Remittal to the department of first instance (yes)

Decisions cited:

Catchword:



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Chambres de recours**

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Case Number: T 0857/12 - 3.3.05

D E C I S I O N
of Technical Board of Appeal 3.3.05
of 6 November 2014

Appellant: Precision Combustion, Inc.
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Appellant: Honda Motor Co., Ltd.
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Decision under appeal: **Decision of the Examining Division of the
European Patent Office posted on 8 November 2011
refusing European patent application
No. 09157393.1 pursuant to Article 97(2) EPC.**

Composition of the Board:

Chairman G. Raths
Members: J.-M. Schwaller
P. Guntz

Summary of Facts and Submissions

I. This appeal lies from the decision of the examining division refusing European patent application No. 09 157 393.1.

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

"A fuel reformer (10), comprising:

- a reforming portion (15) that dry reforms a fuel by way of an oxidizer to generate a hydrogen-rich fuel gas;*
- a fuel inlet portion (11), comprising an electromagnetically driven injector (11a), that introduces the fuel;*
- an oxidizer inlet portion (12) that introduces the oxidizer;*
- a mixer (13) that mixes the fuel and oxidizer introduced;*
- a supply portion (11, 12, 13) that supplies to the reforming portion (15) the fuel and oxidizer as mixed in the mixer (13); and*
- a reformer outlet portion (16) that discharges the hydrogen-rich fuel gas generated in the reforming portion (15),*

the reforming portion (15) comprising a tubular catalytic converter (15a) having an inside diameter D_1 and an outside diameter D_2 and comprising a substrate supporting a catalytic component, the tubular catalytic converter (15a) being arranged to have a center axis extending along a supply direction of the fuel and oxidizer supplied from the supply portion (11, 12, 13), and a catalytic converter passage extending between a catalytic converter inlet and a catalytic converter outlet,

the catalytic converter inlet being defined by an inner wall of the tubular catalytic converter (15a) and communicating with the supply portion (11, 12, 13), the catalytic converter outlet being defined by an outer wall of the catalytic converter (15a) and communicating with the reformer outlet portion (16), the fuel and oxidizer supplied from the supply portion (11, 12, 13) to the catalytic converter passing from the inner wall of the catalytic converter (15a) to the outer wall thereof by diffusing radially characterized in that the catalytic converter satisfies the following relationship:

$$L > (D_2^2)/(4D_1)$$

wherein L is the length, D₂ is the outside diameter, and D₁ is the inside diameter of the catalytic converter (15a), and in that the inside diameter D₁ and the outer diameter D₂ are adapted such that a catalytic converter inlet linear velocity of the fuel and oxidizer in the catalytic converter passage at the catalytic converter inlet is between 5 to 30 times a catalytic converter outlet linear velocity in the catalytic converter passage at the catalytic converter outlet, thereby reforming fuel."

The examining division held this claim to extend beyond the content of the application as filed, in particular because:

- the replacement in claim 1 as filed of the feature "communication passage" by the expression "catalytic converter passage extending between a catalytic converter inlet and a catalytic converter outlet" was not directly and unambiguously derivable from the application as originally filed.

- the position of the reactor's inlet and outlet was not directly and unambiguously identifiable in the application as filed. It followed that the replacement of the feature "*a communication passage defining a reactor inlet and a reactor outlet, the reactor inlet arranged along an inner wall of the catalytic converter and communicating with the supply portion*" by the expression "*the catalytic converter inlet being defined by an inner wall of the tubular catalytic converter (15a) and communicating with the supply portion (11, 12, 13), the catalytic converter outlet being defined by an outer wall of the catalytic converter (15a) and communicating with the reformer outlet portion (16)*" was not directly and unambiguously derivable from the application as filed.

Claim 1 of the auxiliary request underlying the decision read as follows:

"Method of reforming fuel by using a fuel reformer (10), comprising:

- *a reforming portion (15) that dry reforms a fuel by way of an oxidizer to generate a hydrogen-rich fuel gas;*
- *a fuel inlet portion (11), comprising an electromagnetically driven injector (11a), that introduces the fuel;*
- *an oxidizer inlet portion (12) that introduces the oxidizer;*
- *a mixer (13) that mixes the fuel and oxidizer introduced;*
- *a supply portion (11, 12, 13) that supplies to the reforming portion (15) the fuel and oxidizer as mixed in the mixer (13); and*

- a reformer outlet portion (16) that discharges the hydrogen-rich fuel gas generated in the reforming portion (15),

the reforming portion (15) comprising a tubular reactor in form of a catalytic converter (15a) having an inside diameter (D_1 ; D_{T-in}) and an outside diameter (D_2 ; D_{T-ex}) and comprising a substrate supporting a catalytic component, and the tubular catalytic converter (15a) being arranged to have a center axis extending along a supply direction of the fuel and oxidizer supplied from the supply portion (11, 12, 13),

- at least one selected from a glow plug (14) and a spark plug within the hollow portion of said catalytic converter and
- a communication passage comprising the hollow portion and defining a reactor radial inlet, and a reactor radial outlet, the reactor radial inlet arranged along an inner wall of the tubular catalytic converter (15a) at said inside diameter (D_1 ; D_{T-in}) and communicating with the supply portion (11, 12, 13) and the reactor radial outlet arranged along an outer wall of the tubular converter at said outside diameter (D_2 ; D_{T-ex}),
- the fuel and oxidizer supplied from the supply portion (11, 12, 13) to the catalytic converter passing from the inner wall of the tubular catalytic converter (15a) to the outer wall thereof by diffusing radially,

characterized in that a reactor inlet linear velocity of the radially diffusing fuel and oxidizer in the tubular converter (15a) is between 5 to 30 times a reactor outlet linear velocity of the radially diffusing fuel and oxidizer in the tubular catalytic converter (15a) thereby reforming fuel and that the reactor inlet linear velocity is between

35 and 150 cm/sec and the reactor outlet linear velocity is between approximately 5 and 20 cm/sec."

The examining division held the above claim to extend beyond the application as filed because the following features were not directly and unambiguously derivable from it:

- *"a tubular reactor in the form of tubular catalytic converter";*
- *"a communication passage comprising the hollow portion and defining a reactor radial inlet, and a reactor radial outlet, the reactor radial inlet arranged along an inner wall of the tubular catalytic converter (15a) at said inside diameter (D_1 ; D_{T-in}) and communicating with the supply portion (11, 12, 13) and the reactor radial outlet arranged along an outer wall of the tubular converter at said outside diameter";*
- *"a reactor outlet linear velocity of the radially diffusing fuel and oxidizer in the tubular catalytic converter (15a)".*

Claim 1 of the auxiliary request also did not meet the requirements of Article 84 EPC because, owing to the presence of a glow plug in the communication passage, it was unclear how the "reactor inlet linear velocity" could be set since part of the plug filled the communication passage so that equal distribution of the reactants was prevented.

As an obiter dictum, the examining division held that the subject-matter of claim 1 of both requests underlying the decision lacked an inventive step over

the combination of the teachings in documents D1 and D4.

- III. With its statement of the grounds of appeal, the appellant submitted four sets of amended claims as a main request and auxiliary requests 1 to 3.
- IV. By letter dated 23 May 2014, the board expressed its preliminary opinion regarding the four new requests. In particular, it held that claim 1 of the main and first auxiliary requests gave rise to objections under Article 56 EPC and that claim 1 of the second auxiliary request did not meet the requirements of Article 123(2) EPC.

The board judged that claim 1 of the third auxiliary request met the requirements of Articles 84 EPC and 123(2) EPC. Said claim reads as follows:

*"1. Method to dry reform a fuel being light oil by way of an oxidizer to generate a hydrogen-rich fuel gas; said fuel reformer (10) comprising:
a reforming portion (15) that dry reforms the fuel, a fuel inlet portion (11), comprising an electromagnetically driven injector, that introduces the fuel,
an oxidizer inlet portion (12) that introduces the oxidizer;
a mixer (13) that mixes the fuel and oxidizer as introduced;
a supply portion (11, 12, 13) that supplies the fuel and oxidizer as mixed in the mixer (13) to the reforming portion (15),
and an outlet portion that discharge the hydrogen-rich fuel gas generated in the reforming portion (15);
wherein the reforming portion (15) includes*

- a tubular catalytic converter (15a) comprising a substrate supporting a catalytic component, the catalytic converter (15a) being arranged to have a center axis extending along a supply direction of the fuel and oxidizer supplied from the supply portion (11, 12, 13),

- and a communication passage (15b) arranged along an inner wall of the catalytic converter (15a) and communicating with the supply portion (11, 12, 13);

wherein the fuel reformer (10) includes an ignition device such as a glow plug or spark plug in the communication passage (15b);

wherein the fuel and oxidizer supplied from the supply portion (11, 12, 13) to the communication passage (15b) pass from the inner wall of the catalytic converter (15a) to an outer wall thereof by diffusion radially, thereby reforming the fuel to the hydrogen-rich fuel gas

characterized in that for removing carbon built-up the fuel reformer is periodically operated by the fuel injector under fuel lean conditions."

- V. By a letter dated 29 September 2014, the appellant abandoned the first three requests then on file and requested that a patent be granted on the basis of claims 1 to 10 of the third auxiliary request dated 23 May 2014, which is now the sole request on file or, alternatively, that the case be remitted to the department of first instance for further prosecution on the basis of this request.

Reasons for the Decision

1. Allowability of the amendments to claim 1 of auxiliary request 3 of 23 May 2014

The examining division held that some features had no basis in the application as originally filed. These features have now been excised from the claimed subject-matter. Furthermore, the amended subject-matter of claim 1 at issue has a basis in paragraphs [0016], [0024], [0025], [0058], [0063] and [0064] of the application as filed.

It follows that claim 1 at issue meets the requirements of Article 123(2) EPC.

2. Clarity of claim 1 of auxiliary request 3 of 23 May 2014

The examining division held that some features were not clear. These features have now been excised from the subject-matter of claim 1 at issue.

For the board, the subject-matter of claim 1 now on file is clear, concise and supported by the description. Claim 1 thus meets the requirements of Article 84 EPC.

3. Remittal

The contested decision concerned only whether or not the subject-matter of claims 1 of the main and auxiliary requests then at issue was clear and/or had a basis in the application as filed. The board observes that the reasons which led to the above decision to refuse the application no longer apply.

Amended claim 1 is now characterised by the removal of carbon build-up by periodically operating the fuel injector under fuel lean conditions, which feature generates fresh issues not yet addressed in examination proceedings. The board therefore exercises its discretion under Article 111(1) EPC and remits the case to the department of first instance for further prosecution.

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 for further prosecution on the basis of the claims of the third auxiliary request dated 23 May 2014.

The Registrar:

The Chairman:



C. Vodz

G. Rath

Decision electronically authenticated