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Datasheet for the decision of 11 September 2020

Case Number: T 1547/17 - 3.2.04

Application Number: 08705768.3

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Language of the proceedings: EN

Title of invention:
METHOD FOR REDUCING DIESEL ENGINE EMISSIONS, AND DIESEL ENGINE

Applicant:
Mack Trucks, Inc.

Headword:

Relevant legal provisions:
EPC Art. 56
EPC R. 103(1)(a)

Keyword:
Inventive step - (yes)
Reimbursement of appeal fee - substantial procedural violation (no)

Decisions cited:
T 0970/10

Catchword:

Europäisches Patentamt
European Patent Office
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Beschwerdekammern

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Case Number: T 1547/17 - 3.2.04

D E C I S I O N
of Technical Board of Appeal 3.2.04
of 11 September 2020

Appellant: (Applicant)	Mack Trucks, Inc. 7900 National Service Road Greensboro, NC 27409 (US)
Representative:	Valea AB Box 1098 405 23 Göteborg (SE)
Decision under appeal:	**Decision of the Examining Division of the European Patent Office posted on 27 February 2017 refusing European patent application No. 08705768.3 pursuant to Article 97(2) EPC.**

Composition of the Board:

Chairman	S. Oechsner de Coninck
Members:	C. Kujat
	W. Van der Eijk

Summary of Facts and Submissions

I. The appellant (applicant) lodged an appeal, received on 18 April 2017, against the decision of the examining division, dated 27 February 2017, refusing the application No. 08705768.3. The appeal fee was also paid on the same day. The statement setting out the grounds of appeal was received on 9 June 2017.

II. The examining division came to the conclusion that the subject-matter of claim 1 according to the main request and auxiliary requests 1 to 4 lacked an inventive step and thus did not meet the requirements of Articles 52 and 56 EPC having regard to the state of the art as disclosed in document:

D3: WO 2007/107865 A2

The following documents were also cited in the European search report:

D1: WO 2007/136142 A1
D2: US 2007/271918 A1
D4: WO 2007/076038 A2

III. In a communication pursuant Article 17(2) RPBA following the summons to oral proceedings on 26 March 2020, the Board gave its provisional opinion concerning the issues relevant to the case.

IV. In a letter of 3 April 2020 the appellant filed amended pages of the description adapted to the claims of the pending main request.

V. In a letter of 10 July 2020 the appellant requested to issue a decision as regards the reimbursement of the appeal fee during the course of the written procedure.

VI. Order cancelling oral proceedings was dispatched on 16 July 2020.

VII. The appellant requests cancellation of the decision under appeal and grant of a patent on the basis of the main request filed on 24 November 2016 and re-filed with the grounds of 9 June 2017, alternatively on the basis of one of the auxiliary requests 1 to 4 re-filed with the grounds. The appellant requests reimbursement of the appeal fee pursuant Rule 103(1)(a) EPC by virtue of a substantial procedural violation.

VIII. Claim 1 of the main request reads as follows:
"A method for controlling emissions during low-load diesel engine operation, the engine comprising at least one piston (23) movable in a cylinder (25) between a top dead center and a bottom dead center position, a fuel injector (27) for injecting fuel into the cylinder (25), and a variable geometry turbine (29) through which exhaust from the engine is adapted to flow, the engine also comprising an EGR system with an EGR valve (45) disposed between an inlet and the exhaust of the engine, upstream of the variable geometry turbine (29), the method comprising:
operating the engine at low load; and
during said low-load operation of the engine, controlling the NOx emission levels by controlling the inlet opening size of the variable geometry turbine (29) and the opening of the EGR valve (45) to maintain

an inlet opening size of said variable geometry turbine (29), said inlet opening size being reduced to about 0 - 7.5 % of a maximum inlet opening size, and
an opening of the EGR valve (45), said opening of the EGR valve being 25-60% of a maximum position of the EGR valve (45) and injecting fuel before top dead center of the piston (23)."

IX. The appellant argues as follows.
- The subject-matter of claim 1 according to the main request involves an inventive step when starting from D3 and applying the skilled person's knowledge.
- The appeal fee should be reimbursed as a substantial procedural violation occurred during examination proceedings.

Reasons for the Decision

1. The appeal is admissible.

2. *Subject-matter of the invention*

The application concerns an improvement in exhaust gas recirculation (EGR) in a diesel engine with the aim to reduce NOx emissions at low loads.
The solution is provided in the method claimed in claim 1 for controlling emissions during low-load diesel engine operation, by a specific opening range for the bypass valve to the high pressure EGR combined with a corresponding vane inlet opening size of the turbocharger and an additional advance in fuel injection before the top dead center (TDC).

3. Amendments

Compliance with the provisions of Article 123(2) EPC was not challengedin the present case, and the Board is satisfied that the amended claim 1 according to the main request combines the features of claims 1,4,5,6 and 7 of the published PCT application as originally filed.

4. *Main request - Novelty*

Novelty was not at issue in the present case, and the board is also satisfied that none of the cited documents D1, D2, D3 or D4 discloses all the features of claim 1.

5. *Main request - Inventive step*

5.1 Both the examining division in its decision and the appellant use D3 as starting point for their inventive step argumentation. D3 relates to an exhaust gas control system for an internal combustion engine, and generally concerns exhaust gas recirculation (EGR) used to reduce the amount of nitrogen oxides contained in the exhaust gas discharged from an internal combustion engine, paragraph [0002]. D3 indeed represents a suitable starting point for applying the problem solution approach.

5.2 D3 discloses an internal combustion engine provided with an electronic control unit (ECU) 22, paragraph [0068], that controls valve 5 openings in a low-pressure EGR passage 23, paragraph [0065], and valve 21 openings in a high-pressure EGR passage 15, paragraph [0066]. D3 considers controlling the respective use of the high-pressure EGR device and the low-pressure EGR

device in combination or separately to suppress an increase in the fuel consumption rate as much as possible, paragraph [0012].

5.3 An embodiment of D3 includes a variable geometry turbine inlet (VGT) required by claim 1 and uses a variable vane inlet 32 in the turbine housing 7 of the turbocharger 10 in figure 12, paragraph [0155], the low-pressure EGR passage 23 provides communication between the exhaust 19 downstream of the turbine and the intake duct upstream of the compressor 6. D3 further considers a low load operation represented in figure 2, wherein the high-pressure EGR is mainly used, paragraph 0078 (HPL range).

5.4 The method of claim 1 differs from the control method of D3 at low loads by controlling NOx emission levels by reducing the inlet opening of the VGT to 0-7,5% of the maximum opening, and by opening the EGR valve to 25-60% of the maximum opening, and injecting fuel before top dead center (TDC).

5.5 The above turbine inlet opening range, with the EGR valve opening and fuel injection advance, strikes a good compromise for minimizing the particulate and NOx emissions (sentence bridging pages 4 and 5). From this effect the problem of further reducing exhaust gas emissions at low loads for a turbocharged diesel engine can be formulated.

5.6 The examining division has concluded that it is common knowledge to reduce the VGT opening during low load, as taught in D3 (paragraphs [0044] and [0045]), in order to get sufficient back pressure for high-pressure EGR. The other measure of advancing the injection timing being also known to a skilled person to make a trade-

off between NOx and particle emission as illustrated in D8, figure 15.7-2.

5.7 In the Board's view however, D3 only gives general unspecific guidance on a relative opening amount when a turbine with variable vane opening is used. More particularly, in paragraphs [0044] and [0045] relied upon by the examining division, the reduced opening of the variable nozzle is explained within the framework of fuel consumption rates and increased proportion of high-pressure EGR to total EGR (last sentence of paragraph [0044]). In paragraph [0044] the sole useful teaching is to reduce the variable vane opening as the proportion of high-pressure EGR is increased. In paragraph [0045], which is more specifically related to low loads, the reduced opening of the variable nozzle is explained to be necessary to compensate for the low boost pressure received by the turbine. Thus in relation to low loads operation no relationship between a suitable opening amount of 25% to 60% for an EGR valve and a corresponding reduction of the inlet opening of the VGT is derivable.

That the skilled person on his own motion might have considered to provide enough back pressure to allow enough exhaust gas recirculation by reducing the opening of a variable vane does not mean that he would have done so by providing the claimed optimised range, including an inlet opening of the VGT reduced to 0-7,5% of the maximum opening, and by opening the EGR valve to 25-60% of maximum opening. This is especially true as contemplating an opening of the EGR valve in D3 the skilled person would furthermore have to consider the degree of opening range for both the low-pressure and high-pressure EGR passages.

Concerning the step of advancing fuel injection the Board also shares the view of the examining division that this measure as such is generally known to have a positive influence on completeness of the combustion, however there appears to be no obvious reason why the skilled person would have considered this measure in addition to the other above mentioned optimised ranges of EGR valve opening and variable vane inlet opening.

5.8 The other cited documents also are silent on any degree of inlet vane opening in relation to a suitable HP EGR recirculation:

- D1 describes increasing the proportion of external EGR against internal EGR in high load conditions to avoid generation of NOx due to high combustion temperature (passage bridging pages 7 and 8). This teaching further decreases external EGR to zero during low loads, and therefore teaches away from the solution of opening the HP EGR valve to 25-60%.
- D2 discloses in paragraph 11 an exhaust emission control device using a NOx reducing catalyst provided in an exhaust gas passage of the internal combustion engine. D2 does not disclose how the bypass valve depicted in the EGR device 6 is controlled, and thus, cannot give useful information on a degree or range of openings at low load.
- D4 in paragraph 4 discloses a high pressure EGR path upstream of a turbocharger turbine and downstream of a turbocharger compressor, and a low pressure EGR path. A target total EGR fraction is determined for compliance with exhaust emissions criteria for adjusting the HP/LP EGR ratio. Therefore as for D3, D4 rather targets finding a suitable ratio between high and low pressure EGR depending on the engine's operating state. No useful information relates to nozzle vane closing rate to HP EGR amount.

5.9 The Board thus concludes that the subject-matter of claim 1 of the main request fulfils the requirements of novelty and inventive step, Article 52(1) with Articles 54(1) and 56 EPC.

5.10 The dependent claims 2 to 11 define further steps of the method of claim 1, claim 12 defines a diesel engine to perform the method of claims 1 to 11. These claims therefore also comply with the requirements of novelty and inventive step, Article 52(1) with Articles 54(1) and 56 EPC.

6. The Board is also satisfied that the description has been brought into line with the claims of the main request.

7. Reimbursement of the Appeal Fee

7.1 The appellant requests reimbursement of the appeal fee pursuant Rule 103(1)(a) EPC by virtue of a substantial procedural violation, in that the decision is based on D8, the public availability of which the examining division failed to prove.

7.2 According to the minutes of oral proceedings, after having heard the appellant (paragraph 3), the examining division concluded that the textbook bearing a foreword of 2005 had been made available before 2008 (page 6, paragraph 1).

7.3 In doing so the examining division has respected the appellant's right to be heard pursuant Art 113(1) EPC. The written decision also briefly indicates the reasons for holding D8 as evidence of the skilled person's knowledge before 2008 (first paragraph, on page 6 of

the decision). D8 is a transcript of a lecture by S. Pischinger with the title "Verbrennungskraftmaschinen Band II", the preface to this 25th edition carries the date 2005. The examining division thus has provided copies of a textbook as supporting evidence of the common general knowledge contested by the applicant, and concluded in accordance with the guidelines for examination G-VII,3.1 (see in particular the last paragraph).

7.4 The appellant further submits that the examining division failure to prove the public availability of D8 prior to the priority date of the present application is a breach of Article 117 EPC.

7.5 It appears to the Board that the question whether it can be assumed that a document with a foreword dated 2005 has been made publicly available before 2008 or whether further proof is required, is open for assessment on the basis of the facts of the case. In case the conclusion of the examining division that no further proof is required would be in error, this would at best derive from an error of judgement related to a substantive issue and thus does not amount to a violation of a procedural nature, see CLBA V.A.9.5.10 b) especially T0970/10 cited therein.

7.6 As no substantial procedural violation can be recognised, the request for reimbursement of the appeal fee pursuant Rule 103(1)(a) EPC is refused.

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 grant a patent based on the following application documents:

Claims:
Number: 1 to 12 of the main request filed with letter of 9 June 2017

Description:
Pages: 1,1A,2-10 filed with letter of 3 April 2020

Drawings:
Sheet 1/1 as published.

The Registrar: The Chairman:

G. Magouliotis S.Oechsner de Coninck

Decision electronically authenticated