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Datasheet for the decision of 28 June 2019

Case Number: T 2399/16 - 3.2.04

Application Number: 07748285.9

Publication Number: 2171234

IPC: F02B29/04, F02B37/013, F02M25/07

Language of the proceedings: EN

Title of invention:
CHARGE AIR SYSTEM AND CHARGE AIR SYSTEM OPERATION METHOD

Applicant:
Volvo Lastvagnar AB

Headword:

Relevant legal provisions:
EPC Art. 56

Keyword:
Inventive step - (yes)

Decisions cited:

Catchword:

Europäisches Patentamt
European Patent Office
Office européen des brevets

Beschwerdekammern

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Case Number: T 2399/16 - 3.2.04

D E C I S I O N
of Technical Board of Appeal 3.2.04
of 28 June 2019

Appellant: (Applicant)	Volvo Lastvagnar AB 405 08 Göteborg (SE)
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 May 2016 refusing European patent application No. 07748285.9 pursuant to Article 97(2) EPC.**

Composition of the Board:

Chairman	S. Oechsner de Coninck
Members:	J. Wright
	C. Heath

Summary of Facts and Submissions

I. The Appeal lies against the decision of the examining division on refusal of the European application 07748285.9. The decision found the subject-matter of claim 1 according to the main request and auxiliary requests 1 to 5 to lack novelty and 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 documents:

D1: FR 2 844 549 A1
D2: US 2003/114978 A1
D3: US 2004/244782 A1
D4: WO 2005/083244 A1
D5: US 7 007 680 B2
D6: EP 0 508 068 A1
D7: US 6 273 076 B1

II. In a communication following the summons to oral proceedings, the Board gave its provisional opinion regarding the requirements of Article 56 EPC.

III. In its letter of 13 May 2019 the appellant requested cancellation of the decision under appeal and granting of a patent on the basis of main request comprising the claims of auxiliary request 1 as filed with the grounds of appeal on 23 August 2016. Alternatively on the basis of the auxiliary requests 2 to 7 all filed with the grounds of appeal on 23 August 2016.

IV. Oral proceedings were cancelled on 26 June 2019.

V. Claims 1 and 14 of the main request read as follows:

"1. Charge air system for a combustion engine (10), comprising
- a first exhaust gas driven turbocharger stage (20) for compression of combustion air supplied to the engine (10) from a first pressure (p1) to a second pressure (p2),
- a second exhaust gas driven turbocharger stage (30) for compression of the compressed air to a third pressure (p3),
- a first heat exchanger (22) being arranged between the first and the second turbocharger stage (20, 30) for cooling the compressed air,
characterized in th at the charge air system further comprises:
- a first intake air bypass (24) for modulating the flow of the air through the first heat exchanger (22) and/or
- a first mass flow control unit (62) for controlling the flow of a cooling medium supplied to the first heat exchanger (22)."

"14. An operation method for a charge air system, the charge air system comprising:
- a first heat exchanger (22),
- a first intake air bypass (24) for modulating the flow of the air through the first heat exchanger (22) and/or
- a first mass flow control unit (62) for controlling the flow of a cooling medium supplied to the first heat exchanger (22),
said method comprising the steps of:
- compressing intake air from a first pressure (p1) to a second pressure (p2) in a first exhaust gas driven turbocharger stage (20),

- compressing the compressed air to a third pressure (p3) in a second exhaust gas driven turbocharger stage (30),
- estimating the amount of water in air taken in by the first turbocharger stage (20),
- estimating a first dew-point temperature (Tdew1) of the air discharged by the first heat exchanger (22) arranged between the first and the second turbocharger stage (20, 30),
- comparing the first dew-point temperature (Tdew1) to an estimated, measured or calculated temperature (T2) of the air exiting the first heat exchanger (22),
- activating the air bypass (24) and/or the cooling-medium mass flow control unit (62) for raising the second temperature (T2) above the first dew-point temperature (Tdew1) if the second temperature (T2) is below the first dew-point temperature (Tdew1)."

VI. The Appellant argues as follows:
- D7 discloses a turboexpander not a turbocharger, therefore the subject-matter of claim 1 is new.
- Starting from D1, the skilled person would not obviously arrive at the solution proposed in claim 1 using the teachings of D2 to D6, because none of these suggests to control a heat exchanger located between two turbocharger stages.

Reasons for the Decision

1. The appeal is admissible.

2. *Subject-matter of the invention*
The application concerns a charge air system with intercooled double turbocharger stages. It is in particular sought to improve reliability by reducing condensation damages (page 1, lines 9-27).

The solution relies on the control of the bypass rate around the first (Low Pressure) heat exchanger or a regulated coolant flow to the same first heat exchanger. Both alternative measures defined in the characterising portion of claim 1 allow to keep the temperature in the engine's intake above dew point temperature (application as published, page 2, lines 4-5).

3. *Amendments*

3.1 Apart from the redrafting in the two part form pursuant Rule 43(1) EPC, amended claim 1 according to the main request further specifies that the first and second boost systems are exhaust gas driven turbochargers. This added limitation is supported by the consistent use of turbocharger stage throughout the original application as filed (e.g. page 6, lines 29-31), whereby the term turbocharger in the field of automotive industry is consistently understood as a device composed of at least a compressor driven by a turbine in the exhaust gas path of an engine (see e.g. Appellant's quotation of the Wikipedia link: https://en.wikipedia.org/wiki/Turbocharger).

3.2 In addition to the above added limitations, the operation method according to Claim 14 also defines the first heat exchanger, the first intake air bypass for modulating the flow of the air through the first heat exchanger, as well as the first mass flow control unit for controlling the flow of a cooling medium supplied to the first heat exchanger as they were already defined in the charge air system of claim 1. Claim 14 also defines in its lines 20 to 21 further ways of arriving at the temperature T2 of air exiting the first heat exchanger, this temperature being estimated,

measured or calculated, as disclosed in the passage bridging pages 9 and 10 of the published application.

3.3 The Board therefore concludes that these amendments comply with the provisions of Article 123(2) EPC.

4. *Novelty*

4.1 Because the independent claims 1 and 14 explicitly require the provision of boost stages in the form of exhaust gas driven turbochargers, the disclosure of D7 held against novelty in the impugned decision, does not take away novelty of the present main request.
In the embodiment according to figure 14, when the compressor 602 is driven by the turbine 652, this operation cannot in the Board's view be considered as a turbocharger operation, and therefore "supercharger/ turboexpander" explicitly disclosed as such in col 21, lines 1-9 of D7 does not fall under the scope of an exhaust gas driven turbocharger. The qualification turboexpander is directly related to the location of the turbine 652 within the air supply (col. 21, lines 9-15), so is clearly different from a turbocharger that has to be installed within an exhaust path in order to be driven by exhaust gas, according to the usual understanding of the person skilled in internal combustion engines.

4.2 As none of the other available disclosures D1 to D6 directly and unambiguously disclose first and second turbocharger stages with a heat exchanger arranged between them and controllable bypass or mass flow control unit to that heat exchanger, the subject-matter defined in claim 1 is novel. The method claim 14 that relies on the features of the system to be operated according to the core steps of activating the bypass and/or the cooling medium mass flow control unit for

raising the temperature above the dew-point temperature is therefore also novel.
The subject-matter of claims 1 and 14 therefore fulfils the requirements of Article 52(1) with Article 54(1) EPC.

5. *Inventive step*

5.1 Both the examining division in its decision and the appellant use D1 as starting point for their inventive step argumentation. D1 discloses a charge air system with two turbocharger stages 4,5 and a first heat exchanger 14 between the first and second turbocharger stages. D1 also disclose a bypass duct controlled by a valve 16 to bypass a second heat exchanger located between the second turbocharger and engine inlet manifold 2 (page 3, lines 1-13; figure 1).

5.2 The Board concurs with the Appellant that the subject-matter of claim 1 differs from D1 by its characterising features defined as an alternative:
- a first intake air bypass for modulating the flow of the air through the first heat exchanger and/or
- a first mass flow control unit for controlling the flow of a cooling medium supplied to the first heat exchanger.

5.3 *Technical problem*

The Board agrees with the technical effect identified by the Appellant on the basis of page 2, lines 4-6: the temperature of the medium being discharged from the first heat exchanger can be kept well above the dew point temperature. Accordingly the objective technical problem to be formulated can, as suggested by the Appellant, be seen as to improve reliability of the

system in D1 in terms of condensation avoidance. This is also in conformity with the problem identified on page 1, lines 25-27 of the application as filed to provide an improved operational reliability understood by the skilled person in the context of condensation problems acknowledged in the overall background of the application (page 1, lines 9 to 23).

5.4 *Non-Obviousness of the solution*

Turning to the documents D2,D5 and D6 as identified in the impugned decision, the Board observes that they provide the following teachings:
- D2 solves the problem of condensation of exhaust gas recirculation (EGR) gas when the EGR cooler excessively cools the exhaust gas, for protecting the intake manifold against condensation (e.g. Paragraph 6). This is done mainly by controlling bypass valve 136 of the EGR cooler 150 and charge air bypass valves 138 around air cooler 174 (paragraph 27) allowing intake manifold temperature to rise.
- D5 discloses an electronic control unit (ECU) for an engine, and solves the problem of condensation for corrosion prevention in the inlet manifold and cylinders (e.g. col 2, lines 4-10 and 52-55). This is done by controlling a bypass valve 100, allowing flow around a charge air cooler (CAC).
- D6 likewise targets condensation build-ups in engine cylinders (col 1, lines 4-7). The solution encompasses controlling a three way valve (17) adjusting the flow of cooling fluid fed to a charge air cooler (4) (col 2, lines 50-54).
Therefore, all these available teachings also concern condensation prevention by different measures for adjusting the bypass around or coolant flow to an air charge cooler. However they target the temperature in

intake manifold or the engines cylinders without addressing the heat exchanger in itself.
Absent any incentive to target the air flow in a heat exchanger itself, the Board is unconvinced by the examining division's assumption that the skilled person would obviously recognise condensation problems to be critical in such components, and that the skilled person does not need to be reminded of this common problem to try to overcome it. The Board is furthermore unconvinced that the skilled person would obviously arrive at the claimed solution using any of the proposed teachings. In implementing any of the solutions presented in D2, D5 or D6 to the charge system according to D1, the skilled person would seek the same technical effect of increasing temperature in the inlet manifold, thereby achieving the reduction of corrosion due to condensation therein as in the downstream engine cylinders. To achieve such a temperature increase, the straightforward application of these teachings would prompt him to also target the control of the by-pass valve 16 to adjust the amount of by pass intake air flow around the heat exchanger located between the second turbocharger and the engine. In so doing he would fail to arrive at the control of a bypass of the first -or low pressure- heat exchanger 14.

Since this straightforward modification would achieve the sought after increased reliability in relation of condensation avoidance, the skilled person had not any particular reason to further modify the air charge system by providing an additional by pass around the heat exchanger 14 as claimed. This is in particular so because modifying the whole intake track by providing an additional bypass, with its control unit around the

first heat exchanger, involves complex structural modifications.
By the same token, the other alternative solution disclosed in D6 of controlling the flow of cooling medium to the heat exchanger would also not be considered by the skilled person as this would imply providing an additional system, namely a mass flow control unit and its hardware and adapting it specifically to the first low pressure heat exchanger. In the Board's view, the skilled person would not do this without an additional incentive to prevent first stage intercooler condensation.

5.5 *Other cited documents*
The examining division also used D4 as an alternative starting point for denying inventive step. D4 however does not disclose any bypass of either one of both heat exchangers 13 or 14 and is therefore more remote and an even less promising starting point than D1. In the Board's view, providing such a bypass specifically targeting the first one of these heat exchangers with an appropriate control would be a modification based on hindsight. As for D3, it discloses a supercharged internal combustion engine having two or more free running turbochargers, with intercoolers (22,24; col 7, lines 40-54). None of the intercoolers is bypassed and the same conclusions as drawn starting from D4 also apply.
D7 aims at optimizing the excess air ratio (lambda), air charge temperature (ACT), and compression temperature of a compression ignition internal combustion engine (col 1, lines 8-12), and therefore would not be considered by the skilled person as useful to solve a problem related to condensation.

5.6 The Board is thus of the opinion that the subject-matter of claim 1 according to the main request fulfils the requirements of inventive step, Article 52(1) with Articles 56 EPC. The same conclusions also apply to the operation method for the charge air system of Claim 14 that further requires the same first heat exchanger to be operated by activating the bypass and/or the cooling medium mass flow control unit for raising the temperature above the dew-point temperature.

6. The dependent claims 2 to 13 define further features of the system of claim 1, and the dependent claim 15 defines further features of the method of claim 14. These claims therefore also comply with the requirements of novelty and inventive step, Article 52(1) with Articles 54(1) and 56 EPC.

7. As to the adaptation of the description, the Board notes that document D1 has been cited in accordance with the requirements of Rule 42(1)b) EPC and pages 2 and 4 also modified to reflect to amendments in claims 1 and 14 in accordance with the requirements of Rule 42(1)c) EPC. Therefore the Board is also satisfied that the description has been correctly adapted to the pending main request.

8. From the above, the Board thus concludes that the grounds for refusal of the application do not hold against the amended main request, that therefore meets the requirements of the EPC.

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: 1 to 15 filed with letter of 23 August 2016 (filed as auxiliary request 1)

   - Description:
   Pages 1 to 13 filed with letter of 13 May 2019

   - Drawings:
   Sheets 1/4-4/4 as published.

The Registrar: The Chairman:

G. Magouliotis S.Oechsner de Coninck

Decision electronically authenticated