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D E C I S I O N
of 11 October 2002

Case Number: T 0772/01 - 3.2.4

Application Number: 95929366.3

Publication Number: 0727011

IPC: F01L 13/06

Language of the proceedings: EN

Title of invention:

Simultaneous exhaust valve opening braking system

Applicant:

CATERPILLAR INC.

Opponent:

-

Headword:

-

Relevant legal provisions:

EPC Art. 54, 56

Keyword:

"Novelty - yes (after amendment)"

"Inventive step - yes (after amendment)"

Decisions cited:

-

Catchword:

-



Case Number: T 0772/01 - 3.2.4

D E C I S I O N
of the Technical Board of Appeal 3.2.4
of 11 October 2002

Appellant: CATERPILLAR INC.
100 Northeast Adams Street
Peoria,
Illinois 61629-6490 (US)

Representative: Wagner, Karl H., Dipl. -Ing.
WAGNER & GEYER
Patentanwälte
Gewürzmühlstrasse 5
D-80538 München (DE)

Decision under appeal: Decision of the Examining Division of the
European Patent Office posted 12 January 2001
refusing European patent application
No. 95 929 366.3 pursuant to Article 97(1) EPC.

Composition of the Board:

Chairman: C. A. J. Andries
Members: T. Kriner
C. Holtz

Summary of Facts and Submissions

I. The Appellant (Applicant) lodged an appeal on 26 March 2001, against the decision of the Examining Division, dispatched on 17 January 2001, refusing the European patent application No. 95 929 366.3. The fee for the appeal was paid simultaneously and the statement setting out the grounds of appeal was received on 28 May 2001.

II. The Examining Division held that the application did not meet the requirements of Article 52(1) EPC in conjunction with Article 54 EPC in view of document:

D1: US-A-4 741 307.

In addition to D1 the following documents have been cited in the search report:

D2: FR-A-2 375 447

D3: US-A-5 309 881

D4: US-A-5 255 650

D5: EP-A-0 512 246

D6: Patent Abstracts of Japan vol. 9 No. 15 (M-409),
3 September 1985 & JP-A-60/075724

D7: Patent Abstracts of Japan vol. 18 no 193 (M-1588),
5 April 1994 & JP-A-06/002520.

III. The appellant requested that the decision under appeal be set aside and a patent be granted on the basis of the following documents:

Claims: Nos. 1 to 16 as submitted during the oral proceedings on 11 October 2002.

Description: Pages 1 and 6 to 21 as published in WO-A-96/04470; pages 2 to 5 and 22 as submitted during the oral proceedings on 11 October 2002.

Drawings: Figures 1 to 3 and 5 as published in WO-A-96/04470; Figures 4, 6 and 7 as submitted during the oral proceedings on 11 October 2002.

IV. The independent claims 1 and 15 read as follows:

"1. An engine comprising a plurality of cylinders, each cylinder having a piston reciprocally movable therein and at least one exhaust valve (124), the engine further comprising an engine compression braking system (10) wherein air compressed during the compression stroke is used for engine braking, and the compressed air is released through said at least one cylinder exhaust valve of a cylinder when the piston thereof is near top dead center, said engine compression braking system (10) comprising: a plurality of hydraulically operated exhaust valve actuators (44, 46, 48, 50), wherein each cylinder has an associated exhaust valve actuator (44, 46, 48, 50), each exhaust valve actuator having an hydraulic input and being coupled to a respective cylinder exhaust valve (124) for opening the respective exhaust valve

(124) upon hydraulic operation of the associated exhaust valve actuator (44, 46, 48, 50); a single hydraulically operated braking control valve (14) having a controlled hydraulic output coupled to the hydraulic inputs of all of said exhaust valve actuators (44, 46, 48, 50); and actuator means (12) for actuating said braking control valve (14) to simultaneously hydraulically operate all of said exhaust valve actuators (44, 46, 48, 50) and for in turn simultaneously opening each associated exhaust valve (124) when one of said pistons is near top dead center in a compression stroke."

"15. An engine compression braking method for a multicylinder engine having a plurality of cylinders, each cylinder having a piston reciprocally movable therein and at least one exhaust valve wherein air compressed during the compression stroke is used for engine braking and the compressed air is released through said at least one cylinder exhaust valve (124) of a cylinder when the piston thereof is near top dead center, said engine comprising: a plurality of hydraulically operated exhaust valve actuators (44, 46, 48, 50), wherein each cylinder has an associated exhaust valve actuator (44, 46, 48, 50), each exhaust valve actuator having an hydraulic input and being coupled to a respective cylinder exhaust valve (124) for opening the respective exhaust valve (124) upon hydraulic operation of the associated exhaust valve actuator (44, 46, 48, 50); and a single hydraulically operated braking control valve (14) having a controlled hydraulic output coupled to the hydraulic inputs of all of said exhaust valve actuators (44, 46, 48, 50); said method comprising the step of: actuating said hydraulically operated braking control

valve (14) during an engine braking cycle for simultaneously hydraulically operating all of said exhaust valve actuators (44, 46, 48, 50) and for in turn simultaneously opening each associated exhaust valve (124) when one of said pistons is near top dead center in a compression stroke."

- V. In support of its requests, the appellant relied essentially on the following submissions:

The most relevant state of the art was represented by D1. The subject-matter of claims 1 and 15 differed from that which was disclosed in this document by the use of a single hydraulically operated braking control valve for simultaneously operating all exhaust valve actuators and for in turn simultaneously opening all exhaust valves when one of the pistons was near top dead center in a compression stroke. Since there was neither a suggestion for using a single braking control valve, nor for opening all exhaust valves for braking an engine, the subject-matter of claims 1 and 15 was not only new, but also based on an inventive step.

Reasons for the decision

1. The appeal is admissible
2. *Amendments*

The subject-matter of claims 1 and 15 is disclosed in Figures 1, 2 and 4 and in the corresponding description on page 9, line 8 to page 13, line 27 of the published application (WO-A-96/04470).

The features of dependent claims 2 to 14 and 16 are disclosed in the published claims 2 to 14 and 17 (see WO-A-96/04470). The description, besides of some formal corrections, has only been adapted to the amended wording of the claims.

Therefore, all amendments meet the requirements of Article 123(2) EPC.

3. *Novelty*

3.1 D1 which represents the most relevant state of the art discloses (in particular in its Figure 3 and in the corresponding description):

an engine comprising a plurality of cylinders (1 to 6), each cylinder having a piston reciprocally movable therein and at least one exhaust valve, the engine further comprising an engine compression braking system wherein air compressed during the compression stroke is used for engine braking, and the compressed air is released through said at least one cylinder exhaust valve of a cylinder when the piston thereof is near top dead center (see column 1, lines 6 to 12), said engine compression braking system comprising: a plurality of hydraulically operated exhaust valve actuators, wherein each cylinder has an associated exhaust valve actuator, each exhaust valve actuator having an hydraulic input and being coupled to a respective cylinder exhaust valve for opening the respective exhaust valve upon hydraulic operation of the associated exhaust valve actuator (see the passages in column 7, lines 34 to 37 and column 4, lines 21 to 24 which disclose that the slave piston 234 shown in Figure 3 may be replaced by separate slave pistons for each valve); a braking control valve

(228, 256) having a controlled hydraulic output (248, see Figure 5) coupled to hydraulic inputs of said exhaust valve actuators; and actuator means (230, 250 and 258, 250) for actuating said braking control valve to simultaneously hydraulically operate exhaust valve actuators and for in turn simultaneously opening each associated exhaust valve when one of said pistons is near top dead center in a compression stroke, and an engine compression braking method for a multicylinder engine as described above.

However, the engine according to Figure 3 of D1 comprises at least two braking control valves (228 and 256) which are operated by solenoids (actuator means: 230, 258). Furthermore, only one set of exhaust valves is opened for braking the engine (see for example the abstract of D1).

The engine shown in Figure 1 of D1 does not comprise any braking control valve, but a hydraulic pulse generator (75).

Consequently, D1 does not disclose the use of a single hydraulically operated braking control valve for simultaneously hydraulically operating all of said exhaust valve actuators and for in turn simultaneously opening each associated exhaust valve as claimed in claims 1 and 15 of the present application.

- 3.2 With respect to these claims, all further documents (D2 to D7) disclose less relevant features than D1. In particular, also these documents do not disclose an engine compression braking system or an engine compression braking method wherein all exhaust valve actuators and all associated exhaust valves are actuated

simultaneously by a single hydraulically operated braking control valve.

3.3 In view of the assessments above, the subject-matter of claims 1 and 15 is novel.

4. *Inventive step*

4.1 On the basis of an engine and a method according to D1, the problem to be solved by the present invention may be regarded as to provide an economical engine compression braking system/method providing increased braking performance and reliable operation over extended operating conditions (see page 5, lines 4 to 7 of the application, WO-A-96/04470).

4.2 This problem is solved by the provision of an apparatus and a method for engine compression braking as set forth in claims 1 and 15, using simultaneous actuation of all of the engine exhaust valves by a single hydraulically operated brake control valve.

4.3 The provision of a single hydraulically operated brake control valve is known from D2. However, since the available state of the art exclusively discloses engine compression braking systems and methods wherein at best a portion of the engine exhaust valves is actuated for compression braking, there is no suggestion for a simultaneous actuation of all of the engine exhaust valves by a single hydraulically operated brake control valve.

4.4 Consequently, the subject-matter of claims 1 and 15 also involves an inventive step.

These claims together with dependent claims 2 to 14 and 16, the amended description and drawings, therefore form a suitable basis for the grant of a patent.

Order

For these reasons it is decided that:

1. The decision under appeal is set aside.
2. The case is remitted to the first instance with the order to grant a patent in the following version:

Claims: Nos. 1 to 16 as submitted during the oral proceedings on 11 October 2002.

Description: Pages 1 and 6 to 21 as published in WO-A-96/04470; pages 2 to 5 and 22 as submitted during the oral proceedings on 11 October 2002.

Drawings: Figures 1 to 3 and 5 as published in WO-A-96/04470; Figures 4, 6 and 7 as submitted during the oral proceedings on 11 October 2002.

The Registrar:

The Chairman:

G. Magouliotis

C. Andries