

BESCHWERDEKAMMERN  
DES EUROPÄISCHEN  
PATENTAMTS

BOARDS OF APPEAL OF  
THE EUROPEAN PATENT  
OFFICE

CHAMBRES DE RECOURS  
DE L'OFFICE EUROPEEN  
DES BREVETS

**Internal distribution code:**

(A)  Publication in OJ  
(B)  To Chairmen and Members  
(C)  To Chairmen

**D E C I S I O N**  
**of 28 April 1998**

**Case Number:** T 0138/96 - 3.2.4

**Application Number:** 90903446.4

**Publication Number:** 0458857

**IPC:** F01L 13/06

**Language of the proceedings:** EN

**Title of invention:**

A method and a device for engine braking a four stroke internal combustion engine

**Patentee:**

AB Volvo

**Opponent:**

MAN Nutzfahrzeuge Aktiengesellschaft

**Headword:**

-

**Relevant legal provisions:**

EPC Art. 54(3), (4)

**Keyword:**

"Novelty (yes)"

**Decisions cited:**

T 0666/89, T 0447/92, T 0511/92

**Catchword:**

-



Europäisches  
Patentamt

European  
Patent Office

Office européen  
des brevets

Beschwerdekammern

Boards of Appeal

Chambres de recours

Case Number: T 0138/96 - 3.2.4

**D E C I S I O N**  
of the Technical Board of Appeal 3.2.4  
of 28 April 1998

**Appellant:** AB Volvo  
(Proprietor of the patent) Assar Gabrielssons väg  
Torslanda  
405 08 Göteborg (SE)

**Representative:** Hellbom, Lars Olof  
H. Albihns Patentbyrå AB  
Box 3137  
103 62 Stockholm (SE)

**Respondent:** MAN Nutzfahrzeuge Aktiengesellschaft  
(Opponent) Postfach 440100  
90206 Nürnberg (DE)

**Representative:** -

**Decision under appeal:** Decision of the Opposition Division of the  
European Patent Office posted 19 December 1995  
revoking European patent No. 0 458 857 pursuant  
to Article 102(1) EPC.

**Composition of the Board:**

**Chairman:** C. A. J. Andries  
**Members:** H. A. Berger  
J. P. B. Seitz

## Summary of Facts and Submissions

I. The appellant (proprietor of the patent) lodged an appeal, received on 13 February 1996, against the decision of the opposition division, dispatched on 19 December 1995, revoking the patent No. 0 458 857. The appeal fee was also paid on 13 February 1996. The statement setting out the grounds of appeal was received on 18 April 1996.

Opposition was filed against the patent as a whole and based on Article 100(a) EPC.

The decision of the opposition division was based on document EP-A-0 379 720 (D4) (priority date: 12 January 1989, publication date: 1 August 1990), which is state of the art according to Article 54(3), (4) EPC for the designated contracting states DE, FR, GB, IT and SE.

II. With the letter of 18 April 1996 the appellant filed a set of claims forming a basis for a first auxiliary request.

Oral proceedings before the board were held on 28 April 1998, during which the appellant stated his intention of amending claim 1 of the first auxiliary request. He also filed a new set of claims forming a basis for a second auxiliary request.

III. The wording of the independent claims 1 and 4 as granted (main request) is as follows:

Claim 1:

"A method for engine braking with a four-stroke internal combustion engine, said engine having for each cylinder (2) at least one inlet valve (7) and at least

one exhaust valve (9) for controlling communication between a combustion chamber (5) in the cylinder (2) and an inlet system (8) and an exhaust system (10) respectively, characterized by opening a communication between the combustion chamber (5) and the exhaust system (10) when the piston (3) is located in the proximity of its bottom-dead-centre position subsequent to the inlet stroke, by closing said communication when the piston (3) has performed less than half the compression stroke and holding the communication closed during part of the compression stroke, by opening said communication when the piston (3) has performed more than half the compression stroke, and by holding said communication open during the remaining part of the compression stroke and during at least a part of the expansion stroke, said communication of the combustion chamber (5) with the exhaust system (10) being effected upstream of a throttling device (13) mounted in the exhaust system and for engine braking being actuated to throttle at least a part of the flow through the exhaust system (10) and therewith cause an increase in pressure upstream of said throttling device (13)."

Claim 4:

"An arrangement for carrying out the method according to any of Claims 1-3 for engine braking with a four-stroke internal combustion engine, said engine having for each cylinder (2) at least one inlet valve (7) and at least one exhaust valve (9) for controlling communication between the combustion chamber (5) of the cylinder and an inlet system (8) and an exhaust system (10) respectively, characterized in that the arrangement includes means for opening during an engine braking operation a communication between the

combustion chamber (5) and the exhaust system (10) when the piston (3) is located in the proximity of its bottom-dead-centre position subsequent to the inlet stroke and for closing said communication when the piston (3) has performed less than half the compression stroke; in that means are provided for opening during an engine braking operation said communication when the piston (3) has performed more than half the compression stroke and for holding said communication open during the remaining part of the compression stroke and during at least part of the expansion stroke; and in that there is provided in the exhaust system (10) downstream of the connection of the combustion chamber (5) with the exhaust system (10) a throttling device (13) which is operative during an engine braking operation to throttle at least a part of the flow through the exhaust system (10) and therewith increase pressure upstream of the throttling device (13)."

IV. The appellant argued that according to the method described in document D4 it is essential that the intake valve is opened between 360° and 540° crankshaft angle. There is no indication that it is possible to cancel this feature if the described braking method is used while keeping a four stroke valve actuation mode. The description, column 2, lines 44 to 46, does not give a clear teaching about the method in the four stroke operation mode. The appellant explained several possibilities using the two stroke braking mode method described in document D4 in a four stroke mode and came to the conclusion that the method of granted claim 1 and the subject-matter of granted claim 4 are new with regard to document D4.

V. The respondent (opponent) argued that column 2, lines 44 to 46 of document D4 clearly indicates that the two stroke braking mode described in document D4 can be used while maintaining the four stroke operation

mode. The respondent drew attention to the problem cited in document D4, according to which the compression end pressure should be increased. Document D4 proposes for the solution of this problem a short opening of the outlet valve not only at the beginning of the compression stroke, but also at the end of the compression stroke in order to increase and to reduce respectively the pressure in the cylinder. The reduction of the pressure in the cylinder results in a reinstatement of the pressure at the outlet side of the outlet valve. This is, according to the respondent, the basic idea of document D4 which would also be considered when using the proposed method in a four stroke mode. Since it is not possible for physical reasons to obtain considerable braking force in the suction and the expansion stroke, there is only left the compression stroke for the use of the method steps known from document D4. Starting from a four-stroke engine all other measures to improve braking force would be absurd.

The respondent further argued that in the usual four stroke operation the intake valve is fully opened in the suction stroke (first stroke) and the exhaust valve is fully opened in the exhaust stroke (fourth stroke) and that there is no additional opening of the intake valve between the first and the fourth strokes. An additional opening of the intake valve would lead to a mode different from that of a four stroke mode. There would be no other reasonable way than to cancel the inlet valve lift between  $360^{\circ}$  and  $540^{\circ}$  crankshaft angle according to the method described in document D4, if the two stroke braking mode were to be used in a four stroke braking mode. All other solutions would be too complicated and too costly and would not be taken into consideration, particularly in this technical field, in which costs are an important factor because of mass production.

The respondent came to the conclusion that the method of the impugned claim 1 lacked novelty.

VI. *Requests*

The appellant (patentee) requested as the main request that the decision under appeal be set aside and that the patent be maintained as granted, and as subsidiary requests that the patent be maintained on the basis of amended claims.

The respondent (opponent) requested that the appeal be dismissed.

**Reasons for the Decision**

1. The appeal is admissible.
2. *Main request*
  - 2.1 Novelty (Claim 1 as granted):
    - 2.1.1 With respect to the opposed patent, document D4 is recognised as being state of the art within the meaning of Article 54(3), (4) EPC for the common designated contracting states. The total information content of this earlier document (see decision T 666/89, section 8, last paragraph) must therefore be considered as far as novelty is concerned.
    - 2.1.2 Document D4 discloses a method for engine braking with a four-stroke internal combustion engine, said engine having for each cylinder at least one inlet valve and at least one exhaust valve for controlling

communication between a combustion chamber in the cylinder and an inlet system and an exhaust system respectively (this is implicitly disclosed in document D4, which is acknowledged by the appellant).

The method further comprises the steps of:

- opening a communication between the combustion chamber and the exhaust system (see figure, first curve "A" following "UT" at 180° crankshaft angle) when the piston is located in the proximity of its bottom-dead-centre position subsequent to the inlet stroke (curve E from 0°-180° crankshaft angle),
- by closing said communication when the piston has performed less than half the compression stroke (first curve "A" following "UT", closing shortly before 270° crankshaft angle)
- and holding the communication closed during part of the compression stroke (space between the two curves "A" following "UT", this space extending from shortly before 270° to 330° crankshaft angle),
- by opening said communication when the piston has performed more than half the compression stroke (at about 330° crankshaft angle, i.e. about 30° before top dead center position),
- and by holding said communication open during the remaining part of the compression stroke (second curve "A" bridging "OT" at 360° crankshaft angle),



- said communication of the combustion chamber with the exhaust system being effected upstream of a throttling device mounted in the exhaust system and for engine braking being actuated to throttle at least a part of the flow through the exhaust system and therewith cause an increase in pressure upstream of said throttling device (claim 1 and column 2, lines 3 to 7).

2.1.3 According to the method described in document D4 (column 1, line 1 to column 2, line 43) the next stroke following the compression stroke at the beginning of which the communication between the combustion chamber and the exhaust system is kept open, is not an expansion stroke, but a new intake stroke, which permits the avoidance of creation of expansion work, improving thereby the braking effect.

Therefore, the method of the impugned claim 1 differs from that described in document D4 by the method step of holding the communication between the combustion chamber and the exhaust system open during at least a part of the *expansion* stroke.

2.1.4 With regard to the alleged lack of novelty it is necessary to investigate if this differing feature remains a differing feature when lines 44 to 46 of column 2 of document D4 are taken into account, i.e. if under these conditions (namely the knowledge of these three lines) it can be stated that document D4 discloses clearly and unambiguously that the communication is held open during at least a part of the expansion stroke (see decisions T 447/92 [section 3], T 511/92 [section 2.2]).

- 2.1.5 Document D4 explicitly states in the last paragraph of the description (column 2, lines 44 to 46) that it would be imaginable to use the *described method* under maintenance of the four stroke operation ("Es wäre auch denkbar, das hier beschriebene Verfahren unter Beibehaltung des Viertaktbetriebes anzuwenden"), but gives no further information thereto.
- 2.1.6 It is agreed with the respondent that in a four stroke power operation mode the third stroke is an expansion stroke and the last stroke is an exhaust stroke during which the exhaust valve fully opens and then closes. It is also true that document D4 is focused on the problem (column 1, lines 21 to 23) of increasing the pressure during the compression stroke, and that this problem is solved by the short opening of the outlet valve at the beginning of the compression stroke for allowing a flow of the gas stored between the outlet valve and a throttle member (column 1, line 46 to column 2, line 2) back into the cylinder, and by an additional short opening of the outlet valve at the end of the compression stroke for reinstalling the pressure at the outlet side of the outlet valve.
- 2.1.7 However, document D4 clearly describes a method in which it is furthermore necessary and advantageous to open the inlet valve during the stroke following the compression stroke in order to further reduce the pressure in the cylinder (see column 2, lines 21 to 37 and claim 1, line 3 of document D4), improving thereby the braking performance.

The description in column 2, lines 44 to 46 is related to this method, when proposing to use this *described method* under maintenance of the four stroke operation.

The board wishes to emphasize that this passage is not related to the inventive idea, but to the "described method", which includes the decrease of the expansion work.

Since furthermore the described method of document D4 would correctly function in a four stroke mode if the inlet valve were opened during the third stroke, it is not unambiguously clear from the proposal in document D4, column 4, lines 44 to 46, to use only a part of the disclosed method and to fully cancel the opening step of the inlet valve in the third stroke of a four stroke operation, so that this third stroke would become a clear expansion stroke. The deletion of the method step relating to the inlet valve opening during the third stroke would even become more doubtful, as such an approach would lead to the disadvantage that the pressure of the compression stroke is only partly reduced. The reduction of this pressure however seems to be an essential part of this disclosed method (see document D4, column 2, lines 21 to 37, and claim 1, line 3), since it reduces the force acting on the piston after the compression stroke.

- 2.1.8 The respondent alleged that the skilled person would not think of maintaining the opening movement of the inlet valve in the third stroke in a four stroke operation mode because of the high costs and the low braking effect in this stroke. These considerations however concern weighing the quality and the cost of the method step, which can be a matter which can influence the investigation of inventive step, but which is of no importance during the investigation of novelty. It might be that it would be obvious for the skilled person to fully cancel the opening movement of

the inlet valve in the third stroke but this is not unambiguously clear from the description of document D4, and this is just what should be the case when assessing novelty.

2.1.9 Document D4 therefore does not provide a full and unmistakable disclosure of all features of claim 1. Therefore the method of claim 1 is novel over document D4.

2.2 Novelty (Claim 4 as granted)

2.2.1 Claim 4 expresses the method of claim 1 in terms of structural features. Although document D4 only describes a method, it is implicit in this description that means are necessary for carrying out these method steps. However, as is explained in the paragraphs 2.1.1 to 2.1.9 above, document D4 does not unmistakably disclose that it is at least a part of the *expansion* stroke during which the outlet valve is still open and it is therefore not unambiguously clear that means thereto are provided.

2.2.2 The arrangement of claim 4 therefore is novel over the disclosure of document D4.

3. Since the appeal was based solely on lack of novelty with respect to document D4 for only a limited number of designated contracting states, and since the lack of novelty arguments brought forward by the respondent cannot be accepted, the board comes to the conclusion that in the present case the sole mentioned ground for the appeal does not prejudice the maintenance of the patent unamended.

Therefore the decision under appeal has to be set aside and the patent maintained unamended.

4. Having allowed the appellant's main request, the board does not need to consider the 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:



N. Maslin

The Chairman:



C. Andries

*Brg PS*

