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D E C I S I O N
of 20 June 1994

Case Number: T 0062/92 - 3.2.4

Application Number: 87201057.4

Publication Number: 0249286

IPC: F02B 31/00

Language of the proceedings: EN

Title of invention:
Combustion engine

Patentee:
Volvo Car B.V.

Opponent:
Bayerische Motoren Werke Aktiengesellschaft

Headword:
-

Relevant legal norms:
EPC Art. 56, 104

Keyword:
"Inventive step (yes)"

Decisions cited:
-

Catchword:
-



Case Number: T 0062/92 - 3.2.4

D E C I S I O N
of the Technical Board of Appeal 3.2.4
of 20 June 1994

Appellant: Bayerische Motoren Werke Aktiengesellschaft
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Representative: -

Respondent: Volvo Car B.V.
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Decision under appeal: Decision of the Opposition Division of the
European Patent Office dispatched on 26 November
1991 rejecting the opposition filed against
European patent No. 0 249 286 pursuant to
Article 102(2) EPC.

Composition of the Board:

Chairman: C.A.J. Andries
Members: P. Petti
J.P.B. Seitz

Summary of Facts and Submissions

I. An opposition against the European patent No. 249 286 was rejected by the Opposition Division in its decision dispatched on 26 November 1991.

The Opposition Division considered that the grounds for opposition did not prejudice the maintenance of the patent as granted, having regard inter alia to document US-A-4 313 410 (D1), which was considered as reflecting the closest prior art.

II. The wording of the single claim of the patent as granted reads as follows:

"Four-stroke combustion engine such as an Otto-motor substantially consisting of the following parts: a cylinder block having at least one cylinder, a piston (4), slidable in said cylinder, a cylinder head with a main inlet channel (6) whose intake opening forms part of the cylinder head (3'), said opening being opened or closed by means of an intake valve (5), to allow air to flow into a combustion chamber (8) between the piston (4) and the cylinder head (3') and with a parallel inlet channel (bypass) (2) for air which is at least substantially separated from the main inlet channel (6) which parallel inlet channel (2) has a discharge opening leading to said main inlet channel (6), upstream of the valve (5), whereby the direction of flow of air flowing out along the valve stem is directed at the ignition point of a spark plug (3) which is mounted in the cylinder head (3'), and that an injection point for fuel (injector) (1) opens into the main inlet channel (6) in such a place and such a position that the centre line of the fuel jet is directed at the valve foot of the inlet valve (5) on injection, characterized in that the upper

side of the piston (4) in its upper dead centre practically touches the lower side of the cylinder head, above said piston, that the combustion of a fuel-air mixture takes place in a portion of the combustion chamber (8), which is located in the piston head (4) eccentrically relative to the centre line of the piston (4), and that the centre line of the discharge opening of the parallel inlet channel (2) is positioned such that the air flowing out of the discharge opening along the valve stem towards the ignition point of the spark plug (3) has an additional velocity component, which is directed downwards towards the combustion chamber (8)."

III. The Appellant (Opponent) lodged an appeal, received on 17 January 1992, against this decision. On the same day the appeal fee was paid. A statement setting out the grounds of appeal was received on 10 February 1992.

With the Statement of Grounds the Appellant filed a new document, namely the document DE-A-2 815 701 (D4) and moreover referred to document DE-A-2 950 754 (D5) which was cited in the description of the patent in suit.

IV. Oral proceedings were held on 20 June 1994.

V. The Appellant essentially argued that the subject-matter of the claim did not involve an inventive step with respect to the combination either of documents D4 and D5 or of documents D1 and D5.

VI. The Respondent (Proprietor) contested the Appellant's arguments by arguing that they were based on an *ex post facto* analysis of the prior art documents.

VII. The Appellant requested that the decision under appeal be set aside and the patent revoked.

The Respondent requested that the appeal be dismissed and the patent be maintained as granted. The Respondent also requested that the part of his costs with respect to attorney's fees relating to analysis of document D4 be assigned to the Appellant.

Reasons for the Decision

1. The appeal is admissible.

2. *Interpretation of Claim 1*

2.1 The following comments are based on the following analysis of the features of the single claim as granted:

(A) Four-stroke combustion engine such as an Otto-motor substantially consisting of the following parts:

(B) a cylinder block having at least one cylinder, a piston (4) slidable in said cylinder,

(C) a cylinder head,

(C1) with a main inlet channel (6) whose intake opening forms part of the cylinder head (3'),

(C1.1) said opening being opened or closed by means of an intake valve (5) to allow air to flow into a combustion chamber (8) between the piston (4) and the cylinder head (3'),

(C2) with a parallel inlet channel (by-pass) (2) for air,

(C2.1) which is at least substantially separated from the main inlet channel (6),

(C2.2) which parallel inlet channel (2) has a discharge opening leading to said main inlet channel (6) upstream of the valve (5),

(C2.2.1) whereby the direction of flow of air flowing out along the valve stem is directed at the ignition point of a spark plug,

(C3) the spark plug (3) is mounted in the cylinder head (3'),

(D) that an injection point for fuel (injector) (1) opens into the main inlet channel (6),

(D1) in such a place and such a position that the centre line of the fuel jet is directed at the valve foot of the inlet valve (5) on injection,

(E) the upper side of the piston (4) in its upper dead centre practically touches the lower side of the cylinder head above said piston,

(F) the combustion of a fuel-air mixture takes place in a portion of the combustion chamber (8), which is located in the piston head (4),

(F1) said portion of the combustion chamber is located eccentrically relative to the centre line of the piston (4),

(G) the centre line of the discharge opening of the parallel inlet channel (2) is positioned such that the air flowing out of the discharge opening along the valve stem towards the ignition point of the

spark plug (3) has an additional velocity component which is directed downwards towards the combustion chamber (8).-

2.2 The Board wishes to underline that the following interpretation of the claim is not intended to determine the extent of protection conferred by the patent in suit with respect to possible infringing constructions but to identify the subject-matter for which protection is sought. This identification is necessary for the substantive examination of the claim, i.e. for comparing the identified subject-matter with the available prior art.

If in opposition (inter partes) proceedings the main request of the patent proprietor is based upon the independent claim of the patent as granted, i. e. upon an unamended independent claim, and if this claim contains features which are not sufficiently clear or whose technical meaning is not immediately clear with respect to the technical effects to which the features give rise, then the description and drawings can be used to interpret the claim.

2.3 In the present case the following features of the claim need to be interpreted:

2.3.1 The features C.1 to C.2.2 contain the expressions "main inlet channel" and "parallel inlet channel". These expressions, which define a particular structural construction as well as a specific motor operating mode, must be interpreted having regard to the technical effect obtained by this construction and its functioning. The purpose of this construction is to reduce the emission of noxious fumes by producing a strong swirling action due to the action of the parallel inlet channel (see description of the patent, column 1,

lines 37 to 43). According to the description of the patent, the parallel inlet channel functions alone at zero load and low partial load, whereas at partial load and full load both channels function (see particularly column 3, lines 62 to 65). These features, which describe the operating mode of parallel and main inlet channels, are considered as implicitly contained in the claim.

2.3.2 Feature C.2.2.1 has to be interpreted on the basis of the description (column 2, lines 11 to 15; column 3, lines 28 to 30: " [The] ... centre line [of the parallel inlet channel] is directed at the ignition point along the valve stem". This means that the centre line of the **outcoming fluid** is directed at the ignition point. This also implies that the air jet of the parallel channel mainly does not touch the inlet valve stem when the inlet valve is open (see column 3, lines 30 to 37; Figure 2).

2.3.3 Feature E describes structurally the spatial relationship between the piston upper side and the lower side of the cylinder head. It is however clear from the whole description of the patent that the purpose of this feature is to produce a "squish" flow. Therefore, this feature implies the existence of a "squish" zone between the piston upper side and the lower side of the cylinder head.

2.3.4 Feature F1 refers to the word "eccentrically" for defining the position of the combustion chamber relative to the piston axis. Since Figures 1 to 3 of the patent show the axis (centre line) of the piston intersecting the cavity (8), this feature has to be construed as defining the position of the centre of volume of the combustion chamber with respect to the piston axis.

Moreover feature F1 is related to feature E in so far as the eccentric position of the combustion chamber permits the "squish" zone and thus the "squish" flow to be increased. It must be understood that the position of the spark plug with respect to the "squish" zone is such that the "squish" flow is directed towards the ignition point (column 3, lines 41 to 44).

2.3.5 Feature G contains the expression "additional velocity component" relating to the flow of air flowing out of the discharge orifice of the parallel inlet channel. This expression indicates that the velocity of the flow has not only a horizontal component but also a downwardly directed component. This interpretation is consistent with Figures 1 to 3 of the patent which show a bore (2) forming the parallel inlet channel having a centre line inclined downwardly. Moreover, according to the description of the patent (column 3, lines 28 to 30) the centre line is directed at the ignition point of the spark plug whose position (according to the drawings) is lower than that of the discharge opening of the parallel inlet channel.

2.4 During the oral proceedings the Respondent agreed with this interpretation of the claim insofar as he declared that the subject-matter of the claim identified by means of the considerations in sections 2.3.1 to 2.3.5 is already implicitly defined by the wording of the claim.

3. *Novelty*

The subject-matter of the claim is regarded as being novel (Article 54 EPC). Novelty has not, in fact, been disputed.

4. *The closest prior art*

4.1 The Board considers document D4 to reflect the prior art closest to the invention. This document (see particularly Figure 1) discloses an engine block provided with main ("Volllastkanal 11") and parallel ("Teillastkanal 10") inlet channels. The parallel inlet channel functions on its own at low partial load and the main inlet channel only functions in addition to the parallel inlet channel at higher partial and full load. The centre line of the discharge opening of the parallel inlet channel is positioned such that the air flowing out of the discharge opening has a velocity component directed downwards. The combustion process takes place in a combustion chamber which is defined - when the piston is in its upper dead position - by a cavity in the piston head. This cavity appears to be concentric with the centre line of the piston.

4.2 Document D1 (see particularly Figures 1 and 2) discloses an engine block provided with two (26 and 44) inlet channels. However, the presence of the smallest inlet channel (44), which always provides **additional** air (cf. Claim 1, column 6, line 12), has the purpose of promoting the atomisation of the injected fuel in order to homogenize the air-fuel mixture (see particularly column 1, lines 46 to 52).

Document D1 therefore certainly does not contain the information that the smaller channel functions completely alone at low partial load, so that it discloses a different technical construction, which although prima facie looking analogous, is in fact dissimilar functionally. For these reasons D1 represents a less promising starting point to challenge the inventive step of the subject-matter of the claim.

5. *Problem and solution*

5.1 According to the description of the patent (see column 2, lines 28 to 38), the combination of features according to the claim makes it possible to meet the European emission requirements (ECE R 1505) for medium-sized vehicles and to improve the fuel consumption.

The technical problem to be solved therefore consists in improving the combustion of an engine such that the noxious emissions are reduced, while retaining a better fuel consumption.

5.2 Seen formally, the subject-matter of the claim - as identified in the above section 2.3 - is distinguished from the closest prior art (document D4) by the features C2.2.1, D, D1, E and F1.

However, the Board wishes to underline that in the present case, which concerns features influencing the combustion in an internal combustion engine, a formal separation between distinguishing and known features is inappropriate since an improvement of the combustion is normally the result of the combination effect of a plurality of interacting features.

5.3 In view of the advantages set out in the description (see column 2, line 28 to column 3, line 4) and since the Appellant did not challenge these advantages, the Board accepts that the technical problem stated above is solved by the co-operation of all the features specified in the claim.

In particular:

The arrangement of the parallel inlet channel according to features C.2 and C.2.1 permits the flow of air to be directed precisely at the ignition point of the spark plug. Moreover the operating mode of the construction with main and parallel inlet channels, in particular the fact that at zero load and low partial load there is no air flow through the main channel, co-operates with the feature C2.2.1 insofar as the direction of flow of air flowing out of the parallel channel is not influenced by the flow of the main channel at zero load and low partial load. These features thus provide a strong swirling action which result in a reduction of noxious fumes (see description of the patent, column 1, lines 37 to 43).

The eccentric position of the combustion chamber according to feature F1 interacts with feature E such that the "squish" flow towards the spark plug is improved (see the above section 2.3.4). Moreover, these features co-operate with the features concerning the arrangement of the parallel inlet channel insofar as the swirling action produced on account of the parallel inlet channel and the "squish" action produced on account of the position of the combustion chamber with respect to the piston are both directed towards the ignition point (see description of the patent, column 1, lines 47 to 51). Moreover these features cooperate with features D, D1, C.2, C.2.1 and G to define the location of the injection point, the parallel inlet channel and the spark plug relative to each other and thus the relationship between the fuel jet, the air jet of the parallel inlet channel and the ignition point.

6. *Inventive step*

6.1 A skilled person starting from a combustion engine according to document D4 and trying to improve this engine with respect to fuel consumption and noxious emissions would not find in the cited prior art a suggestion either to the combination of features which distinguish the subject-matter of the claim from the closest prior art or to the interaction of these features with each other and with the other features specified in the claim.

6.2 Document D5 which describes the "squish" effect (see particularly page 3, last paragraph) shows in the drawings a piston provided with a cavity (16) which is located eccentrically with respect to the piston axis. Furthermore, the combustion chamber is defined when the piston is in its upper dead position by the cavity (16) formed in the piston head together with a further cavity (5) formed in the cylinder head. Document D5, which relates to the problem of improving the "squish" effect in the context of an engine in which each cylinder is provided with a single inlet channel, cannot provide any suggestion to combine the advantages due to the "squish" flow with those due to the construction with main and parallel channels.

In any case, even if the skilled person were to apply the features known from document D5 and relating to the improvement of the "squish" effect to an engine according to document D4, he would not arrive at the subject-matter of the claim, because neither document D4 nor document D5 suggests the arrangement of a parallel inlet channel in the meaning of the opposed patent in such a way that the air flowing out along the valve stem is directed to the ignition point.

6.3 The argumentation of the Appellant, according to which the subject-matter of the claim is obvious with respect to the combination of documents D4 and D5, is based on an ex post facto analysis of document D4 in so far as the Appellant attributed to the engine according to document D4 also the features C.2.1, D, D1 and E and asserted that the subject-matter of the claim is distinguished from this engine only by feature F1.

The Board cannot accept this interpretation of document D4 for the following reasons:

Document D4 does not explicitly disclose the feature C2.2.1. Furthermore, Figure 1 of the drawings consists of, apart from the piston in its uppermost position, not only a partial cross-section (left-hand part) of the cylinder head, the main and the parallel inlet channels as well as the inlet valve, but also another partial cross-section (the right-hand part of the upper portion of Fig. 1) including the spark plug. It cannot be derived from this drawing that the ignition point of the spark plug is centrally positioned with respect to the air jet of the parallel inlet channel since it is not at all clear in which planes these partial cross-sections are made (cf. the different hatching). Moreover, it appears that the position of the parallel inlet channel with respect to the valve is such that the air jet touches the valve stem when the valve is open.

Document D4, which discloses in Figure 1 an engine with carburettor, explicitly indicates - contrary to the feature D of the patent in suit - that in the case of fuel injection the injector can open in the parallel channel. Furthermore, no information can be derived concerning the direction of the fuel jet (feature D1). Also the indication (page 9, 5th paragraph) of the

location of an injector in the embodiment according to Figure 3 is so general that no other teaching relevant for the present case can be derived.

Although Figure 1 shows a piston whose upper side in the upper dead centre practically touches the lower side of the cylinder head, document D4 does not explicitly disclose the existence of a "squish" zone. The dimension of the borderline zones of the piston head which could produce a "squish" is such that, even if a "squish" were produced, its intensity would be weak and its direction would not be mainly directed towards the spark plug.

6.4 A second chain of argumentation of the Appellant was based on the combination of documents D1 and D5, wherein the engine in Figure 1 of document D1 was considered as being the closest prior art. Having regard to the consideration in the above section 4.2, document D1 cannot be considered as reflecting such a closest prior art. In any case, the information that the flow of the smaller inlet channel is directed at the ignition spark point cannot be unequivocally derived from document D1. Indeed, apart from the fact that it is not explicitly described, it is also not derivable from the drawings. It is quite clear that even in Figure 3 there is no doubt, since its centre line is horizontal and in no way pointing directly at the ignition point. A combination of parts of Figure 1 with parts of Figure 3 could therefore only be the result of an ex post facto analysis, since there is no basis therefor in document D1. Thus, even the combination of documents D1 and D5 could not lead to an engine according to the claim.

6.5 Therefore, the Board considers the subject-matter of the claim as involving an inventive step.

7. The patent can therefore be maintained as granted.

8. *Costs*

The Appellant explained in his letter of 15 December 1993 and during the oral proceedings why he cited document D4 late. According to him, since the expression "additional velocity component" was only fully clarified during the oral proceedings before the Opposition Division, it was only after these oral proceedings that he was able to bring forward an appropriate document taking into account the clarified expression. Furthermore it was emphasised that an interpretation of this expression based on the description was difficult, since the expression only appeared in the claim and its consistory clause in the description.

Having regard to the reasons given by the Appellant, the Board does not consider it to be equitable to order a different apportionment of costs.

Therefore, the Respondent's request concerning costs is rejected.

Order

For these reasons, it is decided that:

1. The appeal is dismissed.
2. The request for apportionment of costs is refused.

The Registrar:



N. Maslin

The Chairman:



C. Andries

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