BESCHWERDEKAMMERN DES EUROPÄISCHEN PATENTAMTS

BOARDS OF APPEAL OF THE EUROPEAN PATENT OFFICE

CHAMBRES DE RECOURS DE L'OFFICE EUROPEEN DES BREVETS

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File Number: T 127/91 - 3.2.4

Application No.: 88 311 584.2

Publication No.: 0 320 233

Title of invention: Multivalve cylinder head

Classification: F01L 1/26

D E C I S I O N
of 26 January 1993

Applicant: Tickford Limited

Headword:

EPC Article 56

Keyword: "Inventive step (yes)"

Europäisches Patentamt | European Patent Office | Office européen des brevets

Beschwerdekammern | Boards of Appeal | Chambres de recours

Case Number : T 127/91 - 3.2.4

D E C I S I O N
of the Technical Board of Appeal 3.2.4
of 26 January 1993

Appellant : Tickford Limited
8 Tanners Drive
Blakelands North
Milton Keynes
Buckinghamshire MK14 5BN (GB)

Representative : GREGORY, T. M.
~~Wain~~, ~~Christopher Paul~~
A.A. Thornton & Co.
Northumberland House
303-306 High Holborn
London WC1V 7LE (GB)

Decision under appeal : Decision of the Examining Division of the European Patent Office dispatched on 20 September 1990 refusing European patent application No. 88 311 584.2 pursuant to Article 97(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. European patent application No. 88 311 584.2, filed on 7 December 1988 and published under the publication number 0 320 233, was refused by a decision of the first instance dispatched on 20 September 1990.

The decision was based on Claims 1 to 7 filed with the letter of 6 December 1989.

II. The reason given in the decision was lack of inventive step of the subject-matter of Claim 1 in comparison with the state of the art disclosed in documents

D1 = EP-A-0 063 385 and
D2 = GB-A-2 058 919.

With regard to the dependent Claims attention was drawn in the decision to the following further documents:

D3 = US-A-2 710 602 and
D4 = US-A-4 667 636.

In the European Search Report also document

D7 = US-A-4 658 780

was cited.

III. An appeal was lodged against this decision on 12 November 1990, paying the appropriate fee on the same date. The statement of grounds of appeal was submitted on 21 January 1991.

IV. In a communication the Board drew attention to the following additional documents:

D5 = GB-A-141 949 and
D6 = EP-A-0 237 295

Oral proceedings took place on 26 January 1993.

During the oral proceedings the Appellant presented diagrams and drawings explaining, for differently arranged inlet valves and for the therewith attained differently shaped combustion chambers, the difference of the swirl effect shown in the form of non-dimensional swirl ratios to be expected in the combustion chambers. He pointed out the improvement of the swirl effect in the combustion chamber with the valve arrangement according to the application and the importance of this swirl effect for the improved efficiency of the engine.

In response to a question of the Board the Appellant amended Claim 1 and argued that the claimed valve arrangement would not be obvious in an engine in which two outer valves are separated by at least one inner valve in such a way that part of their profiles overlap when seen in section parallel to the centre plane. This arrangement would not directly lead to the dome shaped combustion chamber, however an excellent combustion efficiency was achieved with the combustion chamber shape resulting from such a valve arrangement.

The amended Claim 1 reads as follows:

"An internal combustion engine in which each cylinder thereof has a plurality of inlet ports (17,19) and a plurality of outlet ports (14), each port being openable and closeable by means of a respective valve (12,13,11), the inlet (12,13) and outlet (11) valves being disposed substantially on opposite sides of a cylinder centre plane

(16) and angled generally towards said centre plane, there being at least three valves on at least one of said sides arranged with two outer valves (12) separated by at least one inner valve (13), in such a way that part of their profiles overlap when seen in section parallel to the centre plane (16), characterised in that the angle of inclination with respect to said centre plane (16) for said outer valves (12) is less than the angle of inclination for said at least one inner valve (13)."

V. The Appellant requested that the impugned decision be set aside and a patent be granted on the basis of the following documents:

Claims 1 to 7: filed during the oral proceedings on 26 January 1993;

Description: pages 1 to 5 filed during the oral proceedings on 26 January 1993;

Drawings: Figs. 1 to 3 as originally filed.

Reasons for the Decision

1. The appeal complies with the requirements of Articles 106 to 108 and Rule 64 EPC. It is admissible.

2. Amendments

2.1 The present Claim 1 differs from the originally filed Claim 1 in that the words "or equal to" in the characterizing portion of the claim are deleted and the words "in such a way that part of their profiles overlap when seen in section parallel to the centre plane (16)"

are introduced at the end of the pre-characterizing portion.

The added portion of the amended Claim 1 is disclosed in Fig 1. The cancelled feature in the characterizing portion of Claim 1 was only related to an alternative valve arrangement. The amendments therefore do not contravene Art. 123(2) EPC.

2.2 Claims 2 to 7 correspond to originally filed Claims 2 to 7.

2.3 The amendments in the description relate to an adaptation of the description to the newly filed Claim 1. These amendments do not give rise to any objection.

2.4 The application, therefore, does not contravene Article 123(2) EPC.

3. Novelty

After examination of the cited documents, the Board is satisfied that none of them discloses an apparatus having all the features defined in Claim 1. Novelty was not disputed in the decision of the first instance.

The subject-matter as set forth in Claim 1 is to be considered novel within the meaning of Article 54 EPC.

4. Closest State of the Art

Though several of the cited prior art documents disclose an engine with all the features of the pre-characterizing portion of Claim 1, the Board can agree with the Appellant and the Examining Division to take the state of the art disclosed in document D1 as the starting point for the

examination of the application. According to document D1, which describes an internal combustion engine with all the features of the pre-characterizing portion of Claim 1, it is current practice to increase the number of intake valves and the number of exhaust valves for each cylinder of the internal combustion engine. Thereby the so-called "valve area" is increased to improve the charge and discharge efficiencies and to reduce the sizes and weights of the valves so that their followabilities at a high speed can be improved. In this known engine the intermediate intake valve is arranged to face the combustion chamber in such a manner that its valve stem axis forms a smaller angle of inclination with respect to the axis of the corresponding cylinder than that of the remaining intake valves which are arranged at both sides of said intermediate intake valve. This valve arrangement leads to a combustion chamber with a reduced height in the region of the intermediate valve. The basic idea of this prior art is the provision of an engine which can have at least three intake valves and a plurality of exhaust valves without detrimental interference in a combustion chamber and to drive the valves without rendering the system too complicated.

5. Problem and Solution

5.1 The technical problem of the application to be solved with respect to document D1 consists in improving the combustion efficiency of an engine having at least three valves at one side and a plurality of valves at the opposite side with respect to a cylinder centre plane.

5.2 By making the angle of inclination with respect to the centre plane for the outer valves less than the angle of inclination for the at least one inner valve, a very peculiar shape of the combustion chamber, different to

that of the engine described in document D1 is attained with the application. Indeed, due to the fact that the at least three valves located on one side of the cylinder centre plane have overlapping profiles when seen in a section parallel to the centre plane, the surface of that side has a complicated form with at least three surfaces, one for each of the valves, e.g. a surface for each of the two outer valves (Fig. 2) which surfaces are separated from each other in a direction parallel to the centre plane by a third surface (Fig. 3) for the inner valve which surface has a completely different angle than that of the two first surfaces. This combustion chamber shape resulting from the claimed valve configuration can lead, according to the explanation of the Appellant, to an improved swirl effect in the combustion chamber and therefore to an improved combustion efficiency. The explanation, given by the Appellant during the oral proceedings, which is supported by sheets not only explaining the difference in the air flow but also indicating the measured difference in swirl ratio in the combustion chambers having either a valve configuration according to the present application or valve configurations according to documents D1 and D4, cannot be disputed by the Board.

6. Inventive Step

6.1 Since document D1 deals with simplification of the valve driving device and proposes a valve arrangement wherein the valve stem axes of all inlet valves intersect with the sole camshaft axis, this state of the art document cannot lead to the subject-matter of the application according to which the valve stems diverge with respect to each other in the direction of the cam shafts.

6.2 Document D4, which also discloses an engine with all the features of the pre-characterizing portion of Claim 1, shows a valve arrangement in which the inlet valve stems are positioned parallel to one another. The valve arrangement of document D4 would lead to a roof like shaped combustion chamber with the valve heads positioned in only two approximately flat areas. Although such a roof-like shaped combustion chamber might be a compromise on the way to a theoretical optimal dome shaped combustion chamber, it is nevertheless different from the claimed valve configuration.

6.3 Guided by his basic theoretical knowledge of internal combustion engines, according to which a hemispherical shape for the combustion chamber can optimise the combustion, it is possible that a person skilled in the art would try to arrange the valves in a multivalve cylinder head such that an approximately dome shaped combustion chamber can be attained.

Support to such an adaptation in the direction of a dome shaped combustion chamber of a multivalve cylinder head might be given by documents D2 and D5.

Document D2 describes a combustion engine in which the upper wall of the combustion chamber is of an arcuate shape in a vertical plane passing through the major axis of an elongated non-circular cylinder bore. With regard to the centre plane of the cylinder block each of the two sides of the combustion chamber head comprises a row of exhaust valves and a row of intake valves positioned parallel to the centre plane. When seen in parallel to the centre plane the profiles of the valves however do not overlap so that the form of this combustion chamber, at least in the cross-section shown in Fig. 1, resembles the dome shape.

Document D5 which shows a multivalve cylinder head with a hemispherically shaped combustion chamber again does not give any information to use this shape with valves which are arranged in the described overlapping position. Although it is mentioned in the description that two or more inlet and two or more exhaust valves are provided, only the version with two inlet and two outlet valves is shown.

Taking into account the state of the art disclosed by these documents D2 and D5, the modification of an engine with a plurality of inlet ports on one side and a plurality of exhaust ports on the opposite side of the combustion chamber head would lead to an arrangement in which overlapping of the valve profiles seen in a section parallel to the centre plane is prevented in order to attain that arc shape at the combustion chamber head.

6.4 Moreover also other prior art documents cannot lead to the subject-matter of Claim 1. The valve arrangement of document D6 comprises two outer valves and an intermediate valve at one side of the centre plane of the cylinder, however, the angle of inclination with respect to this centre plane for the outer valves is greater than the angle of inclination for the inner valve, similar to the arrangement of document D1.

The engine described in document D3 comprises inlet and outlet valves with parallel stems. The combustion chamber is closed with a plane wall at the cylinder head. The valves are provided in a vertical position with regard to this plane wall of the cylinder head. Also in the engine disclosed in document D7 the intake valves are positioned parallel to one another and the outlet valves are

positioned parallel to one another. With regard to the subject-matter of the application the information given in documents D3 and D7 does not extend beyond the disclosure of document D4.

6.5 When designing a modern high speed engine the skilled person would take into account the valve arrangements then recently proposed. However none of these proposals could lead to the engine of Claim 1. In the highly developed field of engine design it is well known that the arrangement of the valves and the shape of the combustion chamber have a great influence on the efficiency of fuel combustion and on the engine efficiency and that the valve positions in a multivalve cylinder head will influence the combustion chamber shape and this particularly since usually the valve openings are so positioned that they make the best use of the area of the combustion chamber head. Even if the skilled person were to consider a valve arrangement with the stems of the valves at one side of the combustion chamber head diverging in the direction towards their valve driving devices as a practicable solution for the driving device in a multivalve cylinder head, he could not be expected to accept thereby a modification of the combustion chamber to a shape with an unpredictable combustion effect, such as the complicated shape resulting from a valve arrangement in which the profiles of the valves at said one side of the combustion chamber head overlap when seen in section parallel to the centre plane. Indeed, the state of the art concerning engines with at least three valves at one side of the combustion chamber head with regard to the centre plane and with the arrangement in which the valve profiles overlap when seen in section parallel to the centre plane discloses, besides the valve configuration according to which the valve stem axes converge in direction to a simplified driving device, only valves with their stems

parallel to one another. In the attempt to arrive at the advantageous dome shaped combustion chamber the skilled man is guided by the state of the art to position the valves such that the mentioned overlapping and therefore deviation of the arc shape is avoided. He could thereby arrive at a valve arrangement similar to that proposed in document D2, however with the inlet valves at one side and the outlet valves at the opposite side of the combustion chamber head.

6.6 Thus, the subject-matter as set forth in Claim 1 involves an inventive step within the meaning of Article 56 EPC.

7. The subject-matter as set forth in Claim 1 is, therefore, patentable within the meaning of Article 52 EPC, so that a patent may be granted based on this allowable Claim 1, dependent Claims 2 to 7, which concern preferred embodiments of the system according to Claim 1, the modified description and the drawings.

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 an European patent on the basis of the document as defined in above point V.

The Registrar: The Chairman:

N. Maslin C. Andries

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Case Number : T 127/91 - 3.2.4

D E C I S I O N
of 23 April 1993
correcting errors in the **D E C I S I O N**
of the Technical Board of Appeal 3.2.4
of 26 January 1993

Appellant :

Tickford Limited
8 Tanners Drive
Blakelands North
Milton Keynes
Buckinghamshire MK14 5BN (GB)

Representative :

Gregory, Timothy Mark
Urquhart-Dykes & Lord
Midsummer Boulevard
Central Milton Keynes MK9 3BN (GB)

Decision under appeal :

Decision of the Examining Division of the European Patent Office dispatched on 20 September 1990 refusing European patent application No. 88 311 584.2 pursuant to Article 97(1) EPC.

Composition of the Board :

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

In application of Rule 89 EPC the Decision given on 26 January 1993 is hereby ordered to be corrected as follows:

Cover page: replace Representative Wain, C.P. with Gregory, T.M.

The Registrar:

N. Maslin

The Chairman:

C. Andries