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**Datasheet for the decision  
of 15 June 2010**

**Case Number:** T 0733/09 - 3.2.04

**Application Number:** 01118379.5

**Publication Number:** 1178194

**IPC:** F02B 75/04

**Language of the proceedings:** EN

**Title of invention:**

Internal combustion engine with variable compression ratio  
mechanism

**Patentee:**

Nissan Motor Company Limited

**Opponent:**

DaimlerChrysler AG

**Headword:**

-

**Relevant legal provisions:**

EPC Art. 56, 123

**Relevant legal provisions (EPC 1973):**

-

**Keyword:**

"Inventive step - yes"

**Decisions cited:**

-

**Catchword:**

-



Case Number: T 0733/09 - 3.2.04

**D E C I S I O N**  
of the Technical Board of Appeal 3.2.04  
of 15 June 2010

**Appellant:** Nissan Motor Company Limited  
(Patent Proprietor) 2 Takara-cho  
Kanagawa-ku  
Yokohama-shi Kanagawa 221-0023 (JP)

**Representative:** G. Klitsch c/o  
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Stockmair & Schwanhäusser  
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**Respondent:** DaimlerChrysler AG  
(Opponent) Mercedesstr. 137  
D-70327 Stuttgart (DE)

**Decision under appeal:** Decision of the Opposition Division of the  
European Patent Office posted 24 February 2009  
revoking European patent No. 1178194 pursuant  
to Article 101(3)(b) EPC.

**Composition of the Board:**

**Chairman:** M. Ceyte  
**Members:** M. Poock  
T. Bokor

## Summary of Facts and Submissions

I. This appeal is against the decision of the opposition division of 24 February 2009 in which European patent No. 1 178 194 was revoked. Opposition was filed against the patent as a whole and based on the opposition ground of lack of inventive step.

The following documents were cited (inter alia):

D1: DE-U-29 913 107,

D4: Patent Abstracts of Japan of/and JP-A-2000 73 804,

D7: US-A-2 005 000,

D8: Patent Abstract of Japan of/and JP-A-07 167 218.

II. The Patent Proprietor lodged the appeal on 27 March 2009 and simultaneously paid the fee. The statement of grounds of appeal was received on 6 July 2009.

III. Oral proceedings were held on 15 June 2010.

The Appellant (Patent Proprietor) requested that the decision under appeal be set aside and that the patent be maintained in amended form based on the following documents:

Description: columns 1 to 13 filed during the oral proceedings,

Claims: 1 to 19 filed during the oral proceedings,

Figures: 1 to 42 of the patent specification.

The Respondent (Opponent) requested that the appeal be dismissed.

IV. Claim 1 reads as follows:

"Internal combustion engine comprising: a cylinder block (10) having a cylinder (11) in which a piston (50) reciprocates; a crankshaft (100) rotatably installed in said cylinder block (10), said crankshaft (100) including a crank pin (101) and a counter-weight (103); and a variable compression ratio mechanism (60; 70; 80; 90; 82; 92) including an upper link (60) having one end pivotally connected to a piston pin (51) of said piston (50), a lower link (70) pivotally disposed on said crank pin (101) of said crankshaft (100) and having one part pivotally connected to the other end of said upper link (60), a control shaft (90) extending substantially in parallel with said crankshaft (100), a control link (80) having a first end pivotally connected to the other part of said lower link (70) and an eccentric bearing structure (82; 92) through which a second end of said control link (80) is connected to said control shaft (90), so that rotation of said control shaft (90) about its axis induces a pivoting of said lower link (70) about said crank pin (101) thereby varying the stroke of the piston (50), characterized in that said variable compression ratio mechanism is so arranged that when, when viewed in an axial direction (Pa) of said crankshaft (100), said first end of said control link (80) assumes the same side as a rotation axis (Pc) of said control shaft (90) with respect to an imaginary reference line (L) and assumes a most remote position from said imaginary reference line (L), the rotation axis (Pc) of said control shaft (90) is

positioned outside of a circle described by the periphery of said counter-weight (103) and positioned nearer to said imaginary reference line (L) than said most remote position is, said imaginary reference line (L) being a line which extends along an axis of said cylinder (11) through a rotation axis (Pa) of said crankshaft (100), wherein the internal combustion engine further comprises first bearing caps (21,21A,21B,42) which are connected to said cylinder block (10) to rotatably hold said crankshaft (100), said first bearing caps (21,21A,21B,42) being juxtaposed in an axial direction (Pa) of said crankshaft (100), each of said first bearing caps comprises a rounded recess forming part of a bearing portion (23) for rotatably holding the control shaft (90)".

V. The Appellant essentially argued that the subject-matter of amended claim 1 complied with the requirements of the European Patent Convention and in particular is disclosed in the application as originally filed and involved an inventive step.

VI. The Respondent disagreed and essentially argued as follows:

The combination of the first bearing caps 21 with a rounded recess forming part of a bearing portion 23 for rotatably holding the control shaft, was not claimed so far and would clearly extend the protection conferred by the granted patent, contrary to Article 123(3) EPC.

The subject-matter of claim 1 was obvious from the combination of the documents D1, D4 or D7 or from the

combination of these documents with the common general knowledge of the skilled person. Having regard to this knowledge reference was made to document D8.

The general objective for the skilled person was always to keep the well-known construction of combustion engines in which the crankshaft axis intersects the cylinder axis, as shown in document D1.

It was a common matter of choice to support additional shafts in the bearing caps for the crankshaft, near or below it, for increasing the stiffness of the combustion engine. Figure 4 of document D8 showed the bearings of balancing shafts 20, 21 in a combustion engine, in which bearing caps 13 for the balancing shafts are bolted to first bearing caps 8 for rotatably holding the crankshaft.

### **Reasons for the decision**

1. The appeal is admissible.
2. Amendments - claim 1
  - 2.1 Claim 1 is based on original claim 4 referred back to original claim 2. The following features were added:
    - said first bearing caps being juxtaposed in an axial direction of said crankshaft,
    - each of said first bearing caps comprises a rounded recess forming part of a bearing portion for rotatably holding the control shaft.

The first amendment is based on origin claim 3 in conjunction with original claim 4.

The second amendment is based on original claim 4 in conjunction with paragraph 29 of the original description.

Therefore, the amendments comply with the requirements of Article 123(2) EPC.

- 2.2 In claim 1, as compared with its granted version, the last feature was added, defining that the internal combustion engine further comprises particular bearing caps. This limits the extent of protection to an internal combustion engine having, inter alia, such bearing caps.

Therefore, the requirements of Article 123(3) EPC are met.

3. Inventive step - claim 1

- 3.1 Closest prior art

Document D4 relates to a combustion engine of the V-type (see figure 11) including a variable compression ratio mechanism. Details thereof can be best seen in figure 2.

The subject-matter of claim 1 is distinguished therefrom by the feature that the imaginary reference line is a line which extends along an axis of the cylinder through a rotation axis of the crankshaft,

i.e. the crankshaft axis intersects the cylinder axis. Moreover it is distinguished by the last feature of claim 1 referring to the particular bearing caps, i.e. that the bearing caps for the crankshaft also rotatably support the control shaft.

The same can be stated with respect to document D7. However, since this US document is very old (granted in 1935), document D4 is considered of higher relevance for the purpose of assessing inventive step.

Also document D1 relates to an internal combustion engine having a variable compression ratio mechanism. This is shown, very schematically, in figure 1. There, the crankshaft axis intersects the cylinder axis. However it does not disclose a control shaft and an eccentric bearing structure as defined in claim 1. Moreover it does not disclose the last feature of claim 1 relating to the particular bearing caps. Hence, it is less relevant than the documents cited above.

For these reasons, the internal combustion engine known from document D4 is considered to represent the closest prior art.

### 3.2 Derivation of the technical problem

3.2.1 The use of the distinguishing features in the combustion engine of document D4 has the effects that the crankshaft axis intersects the cylinder axis and that the control shaft is rotatably supported by the crankshaft bearing caps, i.e. they must be positioned at the cylinder block near and below the crankshaft.

Hence, the claimed combustion engine has a more compact structure.

By this arrangement the control shaft can serve as a reinforcing beam for the bearing caps, as set out in the patent specification, column 8, lines 21 and 22, so that their vibrations will be reduced (see patent specification, paragraphs 38 and 39).

### 3.2.2 Formulation of the technical problem

The problem to be solved is therefore to provide the internal combustion engine known from document D4 with a compact structure and reduced or minimised vibrations of the bearing caps. Thus, the problem stated in the patent specification, paragraph 8 is in substance correct.

### 3.3 Non-obviousness of the solution

3.3.1 Document D1 shows a standard arrangement for the cylinder and crankshaft in which their axes intersect. However, this is the only available document showing this arrangement with respect to a variable compression ratio combustion engine. Since proof for common general knowledge in general requires evidence in the form of encyclopaedias, text books, dictionaries, handbooks on the subject in question, or exceptionally, a number of patent specifications, a single patent specification D1 is not sufficient for demonstrating that this arrangement is common general knowledge for variable compression ratio combustion engines. Therefore, the skilled person had to combine the internal combustion

engine of document D4 with the teaching of document D1 to arrive at the subject-matter of claim 1.

3.3.2 D8 relates to a combustion engine provided with a balancer supporting device. A plurality of bearing caps 8 for supporting a crankshaft 6 are integrally connected to each other by a bearing beam 13, and balancer shafts 20, 21 are supported by the bearing beam 13 and a balancer holder which is fixed on the lower surface of the bearing beam 13 (see Patent Abstracts of Japan, Abstract). Hence:

- (a) this document does not relate to a variable compression ratio combustion engine and, more particularly, it does not disclose a control shaft as part of the variable compression ratio mechanism. Therefore the Board has doubts whether the skilled person confronted with the above technical problem would in fact consider document D8.
- (b) But even if he would, its teaching would not lead him to the claimed subject-matter.

Then, its bearing beam 13 would be used for reinforcing the bearing caps, as set out in the patent specification, column 8, lines 1 to 5.

Moreover, either D8 or any other of the cited documents, do not give any incentive to the skilled person to use the control shaft for reducing the vibrations of the bearing caps or to move the control shaft 38 from the position shown in figure 2 of document D4 to below and near the

cylinder block and to integrate its bearing into the crankshaft bearing caps.

The Board notes that document D8, thus, does not support the Respondent's submissions that the last feature of claim 1 was common general knowledge.

- 3.3.3 To arrive at the claimed subject-matter, it was not sufficient to apply the teachings of documents D1 and D8 on the known combustion engine, but even further considerations were necessary. In the Board's judgement, this is a clear indication that the skilled person could not arrive at the claimed subject-matter without inventive considerations.
- 3.3.4 The same holds true even if document D1 was used as starting point for assessing inventive step. Also in such case, the last feature of claim 1 is not obvious from document D8 or any other cited document.
- 3.3.5 Consequently, it had to be concluded, that the subject-matter of claim 1 involves an inventive step according to the requirements of Article 56 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 maintain the patent on the basis of the following documents:

Description: columns 1 to 13 filed during the oral proceedings,

Claims: 1 to 19 filed during the oral proceedings,

Figures: 1 to 42 of the patent specification.

The Registrar:

The Chairman:

G. Magouliotis

M. Ceyte