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**Datasheet for the decision  
of 7 February 2017**

**Case Number:** T 0978/14 - 3.2.04

**Application Number:** 10173564.5

**Publication Number:** 2295762

**IPC:** F02B77/08, F01N11/00, F02F1/42

**Language of the proceedings:** EN

**Title of invention:**  
Engine and saddle-riding type vehicle including the same

**Applicant:**  
Yamaha Hatsudoki Kabushiki Kaisha

**Headword:**

**Relevant legal provisions:**  
EPC Art. 56

**Keyword:**  
Inventive step - problem and solution approach

**Decisions cited:**

**Catchword:**



**Beschwerdekammern**  
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Case Number: T 0978/14 - 3.2.04

**D E C I S I O N**  
**of Technical Board of Appeal 3.2.04**  
**of 7 February 2017**

**Appellant:** Yamaha Hatsudoki Kabushiki Kaisha  
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**Representative:** Zimmermann, Tankred Klaus  
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**Decision under appeal:** Decision of the Examining Division of the  
European Patent Office posted on 14 October 2013  
refusing European patent application No.  
10173564.5 pursuant to Article 97(2) EPC.

**Composition of the Board:**

**Chairman** S. Oechsner de Coninck  
**Members:** J. Wright  
C. Heath  
S. Oechsner de Coninck

## Summary of Facts and Submissions

I. The appellant (applicant) lodged an appeal, received on 12 December 2013, against the decision of the examining division, dispatched on 14 October 2013, refusing the application No. 10 173 564. The appeal fee was also paid on 12 December 2013. The statement setting out the grounds of appeal was received on 17 February 2014.

II. The examining division came to the conclusion that the subject-matter of claim 1 lacks an inventive step and thus did not meet the requirements of Articles 52 and 56 EPC having regard to the state of the art as disclosed in document:  
D2: JP 2004 316430 A

The following documents are also cited in the European search report:

D1: JP 11 200913 A  
D3: US 2002/026909 A1  
D4: JP 2008 223728 A  
D5: US 4 831 820 A  
D6: EP 0 719 913 A1  
D7: US 4 903 648 A

III. The appellant requests that the decision under appeal be set aside and that the application be granted on the basis of the main request dated 31 October 2012, alternatively on the basis of the auxiliary request filed on 19 August 2013.

IV. Claim 1 of the main request as now on file reads as follows:  
"A single-cylinder or V-twin-cylinder engine,  
comprising:

a cylinder head (46; 46a; 46b) including a head main body (65) and a projected portion (66; 66a) projecting outwardly from the head main body (65), wherein, when viewed from an engine cylinder axis (A), the projected portion (66; 66a) outwardly extends beyond the circumference of a cylinder head cover (48) mounted to the cylinder head (46; 46a; 46b);  
a combustion recess (70) formed in the head main body (65); an exhaust gas passage (80; 80a) from the combustion recess (70) through the projected portion (66; 66a) for discharging exhaust gas from the combustion recess (70) ; and  
an oxygen concentration sensor (50; 50a) including a main body portion (118; 118a) and a detection portion (120) provided in the main body portion (118; 118a), for detecting an oxygen concentration in the exhaust gas; wherein the oxygen concentration sensor (50; 50a) is mounted to the projected portion (66; 66a), with the main body portion (118; 118a) and the detection portion (120) overlapping the projected portion (66; 66a) as viewed from a direction of the cylinder axis, at least part of the detection portion (120) being located within the exhaust gas passage (80; 80a), wherein neither the main body portion (118; 118a) nor the detection portion (120) are out of the outline of the projected portion (66; 66a) when viewed from the direction of the cylinder axis (A), and wherein the oxygen concentration sensor (50; 50a) does not project beyond the head main body (65) in a left-right direction when viewed from the direction of the cylinder axis (A)."

- V. The Appellant argues as follows:
- Starting from D2 the subject-matter of claim 1 differs by the same features of the sensor as identified by the examining division: neither its main

body portion nor its detection portion are out of the outline of the projected portion when viewed from a cylinder axis direction. The object of the invention is to minimise size increase due to the accommodation of an oxygen sensor.

- The problem solution approach that should consistently be applied according to the guidelines for examination and is the normal practise of the European Patent Office is also applicable in the present situation.

- The skilled person would not rotate the sensor 45° counterclockwise as a matter of obviousness, since the cylinder head flange would obstruct this modification. Since no hint is present in the other cited documents to provide such a limited projection of the sensor, the subject-matter of claim 1 involves an inventive step.

### **Reasons for the Decision**

1. The appeal is admissible.

2. *Subject-matter of the invention*

The application concerns a single-cylinder or V-twin-cylinder engine, comprising an oxygen concentration sensor. The prior art oxygen concentration sensor are located close to the exhaust to be heated by high-temperature exhaust gas and thereby quickly reach the their activation temperature (paragraphs [0004] and [0005]).

The present application is concerned with compactness of these relatively small engines with one or two cylinders and in particular aims at reducing size increase of an engine having an oxygen concentration cylinder (published application paragraph [0026]).

The solution is provided by the following key concepts: no portion of the oxygen concentration sensor projects out of the outline of a projected portion of the cylinder head when viewed from the direction of the cylinder axis, nor projects beyond the head main body in a left-right direction when viewed from the direction of the cylinder axis.

3. *Amendments*

The amended claim 1 according to the main request combines claims 1 and 6 as originally filed but refines the definition of the projected portion and the arrangement of the oxygen concentration sensor.

- The projected portion is emphasised to be an outer circumferential surface of the head main body by extending beyond the circumference of the head cover which derives from the passage bridging pages 15 to 16 of the application as filed together with figures 4 and 6.

- Furthermore the arrangement of the oxygen concentration sensor is taken from page 9, lines 2 to 5 (paragraph [0029] of the published application), so that it now claims in more precise terms the central features of the sensor according to the invention, namely that neither its main body portion nor its detection portion are out of the outline of the projected portion when viewed from the direction of the cylinder axis.

The Board therefore concludes that these amendments comply with the provisions of Art. 123(2) EPC.

4. *Novelty/inventive step*

4.1 The decision found the subject matter of claim 1 to be new (impugned decision, paragraph bridging pages 1 and 2). The Board is also satisfied that none of the

available cited documents disclosed all the features of the amended claim 1.

4.2 The document D2 was used as starting point in the impugned decision and corresponds to the prior art quoted in the application on page 1 in relation with figures 19a and 19b. When compared with this disclosure that the appellant also considers to represent a suitable starting point for assessing inventive step, it is undisputed that the subject-matter of claim 1 differs therefrom in that neither the main body portion nor the detection portion -of the sensor- are out of the outline of the projected portion when viewed from a cylinder axis direction.

4.3 Problem solution approach

The examining division considered that the problem solution approach was inappropriate in the present case because it would be difficult to formulate a realistic technical problem (decision, reasons, page 2, 2nd paragraph). The guidelines for examination indeed foresees exceptional deviation from this approach (Guidelines for examination G-VII.5). Nevertheless the problem-solution is regularly applied by the departments of the EPO in the course of deciding whether or not claimed subject-matter fulfils the requirements of Art. 56 EPC and was primarily developed to ensure objective assessment of inventive step and avoid ex post facto analysis of the prior art, see Case Law of the Boards of Appeal, 8th edition, 2016 (CLBA hereinafter), I.D.2.

In the present case, considering that the examining division started from document D2 and identified technical differences with respect to the subject-matter of claim 1, the Board considers it is possible



to formulate a technical problem based on the assessment of the technical effect of the identified differences. Therefore the Board sees no reason not to apply the standard problem solution approach.

#### 4.4 Technical Problem

The effect of having the sensor extending within the outwardly projecting surface in the axial direction of the piston is to provide a single or V-twin cylinder engine with reduced lateral size as identified in similar terms in paragraph [0008] of the application as published. Therefore the objective technical problem can be formulated as improving the lateral compactness of a single or V-twin cylinder engine having an oxygen concentration sensor mounted on a projected portion of the cylinder head, such as that of D2.

#### 4.5 Non-obviousness of the solution

The Board shares the appellant's view that merely rotating the oxygen sensor of D2 (see fig 6, sensor 68; identical to fig 19a, 6a of the application) by 45° anticlockwise as argued by the examining division cannot directly be performed by the skilled person because the sensor body would interfere with the cylinder head mounting flange 82 (see fig 5).

Even considering that the person skilled in the art, a mechanical engineer working in the field of combustion engines, might consider moving the sensor to solve the above problem, the Board does not think he would obviously arrange the sensor to align axially with the cylinder so as not to project beyond the projected portion as claimed.

Such a modification of the arrangement of D2 would not be straightforward, because it implies other modifications of the cylinder head and exhaust duct with associated flange beyond the mere rotation of the

sensor and its attachment 45° counterclockwise. In particular, in addition to the cylinder head flange, since the sensor mounting flange is located within a space between boss 84 and the attachment flange surface 85 of the exhaust pipe 61 laterally flush with the piston maximum lateral extension any "rotation" would extend the lateral extension of the projection which would increase engine size rather than making it more compact.

#### 4.6 Other cited documents

Further, considering the other cited documents, the skilled person may also select D4 as suitable starting point of a single or twin piston engine having a similar projecting portion 23 and sensor 28 (see figures 9 and 10). He would however be faced with similar constructional difficulties as in D2. Modifying the architecture of the cylinder head 44 to align the sensor body 32 with the projecting portion 23 in an axial direction of the cylinder, so that it did not project as claimed would require the same far reaching modification of the cylinder head and attachment flange.

- The document D3 ([0001];[0022]; fig 1-5) discloses a multi-cylinder engine equipped with the oxygen sensor 24 mounted on a laterally projecting portion of the exhaust pipe 26. As depicted the sensor body extends in almost the same axial direction of the cylinder 8. However, the skilled person would not seek a solution to the above problem in a large multi-cylinder engine (cf. D3, figure 1, V-type 6 cylinder engine). Therefore this teaching would not prompt the skilled person to provide the same arrangement of sensor on the single-cylinder engine of D2 or D4, in particular, far from offering a compact solution the projecting portion on

which the sensor is mounted extends well beyond the lateral surface of the cylinder head 7 and the alignment of the sensor is thus not provided to allow a reduced size of the engine.

- The other cited documents D1 (Abstract and figure), D5 (fig 1), D6 (fig 1 and 2) and D7 (figure 1) all disclose sensors extending from a projecting portion of the exhaust duct at an angled position with respect to the cylinder axial direction, thus do not provide the skilled person with a hint towards the solution of claim 1.

5. The Board concludes, therefore, that the subject-matter of claim 1 of the main request fulfils the requirements of novelty and inventive step, Article 52(1) with Articles 54(1) and 56 EPC.
  
6. The dependent claims 2 to 15 define further features of the engine of claim 1 and claims 16 and 17 define a saddle riding type vehicle comprising such an engine. These claims therefore also comply with the requirements of novelty and inventive step, Article 52(1) with Articles 54(1) and 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 grant a patent based on the following application documents:

#### Claims:

1 to 17 filed with letter of 30 October 2012

#### Description:

Pages 1 to 38 as originally filed.

#### Drawings:

Sheets 1/20 to 20/20 as originally filed.

The Registrar:

The Chairman:



G. Magouliotis

S. Oechsner de  
coninck

Decision electronically authenticated