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Datasheet for the decision of 7 September 2007

Case Number: T 0879/04 - 3.2.04

Application Number: 96917324.4

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IPC: F02B 75/32

Language of the proceedings: EN

Title of invention:
Double circular slider crank reciprocating piston internal combustion engine

Patentee:
Liao Ning Daan Internal Combustion Engine

Opponent:
-

Headword:
-

Relevant legal provisions:
EPC Art. 52(1), 56

Keyword:
"Inventive step (yes)"

Decisions cited:
-

Catchword:
-

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Case Number: T 0879/04 - 3.2.04

D E C I S I O N
of the Technical Board of Appeal 3.2.04
of 7 September 2007

Appellant: Liao Ning Daan Internal Combustion Engine Institute
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Decision under appeal: **Decision of the Examining Division of the European Patent Office posted 2 January 2004 refusing European application No. 96917324.4 pursuant to Article 97(1) EPC.**

Composition of the Board:

Chairman: M. Ceyte
Members: A. de Vries
H. Preglau

Summary of Facts and Submissions

I. The Appellant lodged an appeal, received at the EPO on 1 March 2004, against the decision of the Examining Division posted 2 January 2004, refusing the European patent application no. 96 917 324.4 and simultaneously paid the required appeal fee. The grounds of appeal were received 29 April 2004.

II. In its decision the Examining Division held that the application did not meet the requirements of Articles 52(1) and 56 EPC having regard to the following documents in particular:

D1: DE-A-1451923

D2: US-A-4173151

D4: US-A-5067456

During examination pursuant to Article 96 EPC the further relevant document was cited:

D3: CN2076608U.

III. In response to a note of a telephone attendance on 7 May 2007 issued by the Board the Appellant with letter of 6 June 2007 submitted amended claims and description pages. With a telephone consultation of 3 September 2007 the Appellant approved amendments to bring the description in line with the new claims. Consequently he requests, as sole request, that the decision under appeal be set aside and a patent be granted based on the following documents:

Claims

No.: 1,2 filed with letter of 6 June 2007

Description

Pages: 1 to 5 filed with letter of 6 June 2007

Pages: 6 to 14 as filed with letter of 2 November 2001

Figures

Drawings, sheets 1/8,2/8,4/8-8/8 as published

Drawing, sheet 3/8 as filed with letter of 2 November 2001

with the following minor amendments to the description as approved by the Appellant in the telephone consultation of 3 September 2007:

page 6, deletion of lines 1 to 13 (which repeat the last 13 lines of page 5)

page 11, line 22: deletion of "according to the invention"

page 12, line 8: deletion of "according to the invention"

page 12, last line: replacement of "embodiments" [plural] by "embodiment" [singular].

IV. The wording of the claim 1 of the sole request is as follows:

1. "A double cylinder reciprocating piston internal combustion engine arranged in an I-form, said engine comprising:

a cylinder body (1);

a crank circular slide block mechanism which comprises a cylinder (8) in the cylinder body, a piston (13), a crankshaft (37), and two circular slide blocks (27, 28) having the same size, shape and weight and each having an eccentric axle hole, the eccentric distances (e) thereof (29) being the same, wherein said piston (13) is a double-acting piston and provided with a circular

opening, one of said two circular slide blocks (27, 28) is rotatably mounted in said circular opening (12) said piston (13) being disposed in said cylinder (8), and each said eccentric axle hole (29) is sleeved on the crankshaft (37), wherein said crankshaft (37) contains a main journal (39) and has a single crank structure and wherein said two circular slide blocks (27, 28) are sleeved rotatably on said crankshaft (37) by said eccentric axle holes (29) and firmly fixed at a phase of 180 degree between them; further comprising
a sliding track (26) formed as a cavity in said cylinder body (1) with a central axis perpendicular to the axis of said cylinder and spaced therefrom;
a dynamic balance sliding piece (21) disposed to slidably reciprocate in said sliding track for the dynamic balance in said engine, a circular opening (24) formed on said dynamic balance sliding piece; the other of said two circular slide blocks rotatably mounted in said circular opening (24) of said dynamic balance sliding piece (21);
said dynamic balance sliding piece (21) and said double-acting piston (13, 50) being equal to each other in weight and each having a central axis on which is located its centre of gravity".

Reasons for the Decision

1. The appeal complies with Articles 106 to 108 and Rule 64 EPC and is therefore admissible.

2. *Allowability of amendments under Article 123(2) EPC*

2.1 Claim 1 combines the features of originally filed claims 1,2,5 and 8, and includes the following further features from the description (italics indicate the addition which is followed by the relevant passage in the description as originally filed):
- the engine is a *double cylinder* engine *arranged in I-form*: page 7, lines 12 and 13;
- *same weight* of the two circular slide blocks : page 10, lines 2;
- the sliding track *is formed as a cavity in said cylinder body with a central axis perpendicular to the axis of the cylinder and spaced therefrom:* page 8, third paragraph;
- the dynamic balance sliding piece and the double acting piston are *equal to each other in weight and each have a central axis on which is located its centre of gravity* : page 10, lines 3 to 5.

The Board notes that some of the above features appear in combination with further features that are however not included in the claim. In some instances (e.g. the sliding track and dynamic balance sliding piece having the same cross-section also included on page 8, third paragraph) these further features are recognizable as non-essential, are not presented as such, and are not functionally or structurally related to the above features so that their omission from the claim does not represent an unallowable generalization. In further instances these features are implied by those already in the claim (e.g. the position of the centre of gravity being the same on both slide blocks - page 10, lines 2 and 3 - follows from their same size, shape and

distance of eccentric hole) and therefore need not be included explicitly in the claim. Finally, other features are basic features implicit to the skilled person in the term "internal combustion engine" (e.g. the features included in the first paragraph describing embodiment I on page 7, such as the valve actuating and fuel injection mechanisms which also appeared in original claim 1). These therefore also do not need to be explicitly mentioned in the claim.

The claim is thus limited to the recognizably essential features of embodiment I detailed on page 7 to 10 of the description as originally filed.

2.2 In conclusion, the Board is satisfied that claim 1 has a clear basis in the originally filed application documents and thus meets the requirements of Article 123(2) EPC.

3. *Background of the invention*

The invention concerns a reciprocating piston internal combustion engine which instead of a conventional piston connector rod includes a crank circular slide block mechanism. The mechanism comprises two identical circular slide blocks with eccentric opening, fixed to each other with the openings rotatably mounting a crankshaft. One of the blocks rotates within a circular opening in the piston, the other rotates within a similar opening in a "dynamic balance sliding piece" (DBSP) which reciprocates within a sliding track perpendicular to the axis of the cylinder in which the piston reciprocates. This mechanism, in which piston and DBSP are constrained to move sinusoidally, removes

unbalance due to the (non-sinusoidal movement) of a connector rod.

4. *Novelty*

4.1 Though crank circular slide block mechanisms are known in internal combustion engines, none of the cited documents discloses a dual such mechanism in a double cylinder internal combustion engine *arranged in I form* with *a double acting piston* and where *the perpendicularly arranged DBSP within its sliding track is not part of an acting piston.* This follows from the fact that it is perpendicular to the only piston(s) in the engine, namely the double acting piston of the double cylinder.

D2, see e.g. figures 3 and 4, shows a dual crank circular slide block mechanism in a double cylinder engine, which is however in "V" form with perpendicularly arranged single cylinders, and in which each DBSP is formed as part of a piston.

Further relevant D3, see figures 1,2, 25, 26, shows two circular slide blocks in a 4-cylinder engine in I-form with two parallel double acting cylinders. The slide blocks are not firmly fixed nor sleeved about a single crankshaft, but each cooperates separately with a DBSP formed by its respective double acting cylinder.

The further documents are less pertinent:

D1, see figures 1-4, discloses an eccentric crankshaft mounted for rotation in circular openings of multiple

angularly spaced double acting cylinders without the intermediary of a circular slide block.

D4, figure 1, discloses a hypocycloid gear assembly linking crankshaft and piston, and thus also does not feature circular slide blocks.

4.2 The Board concludes that the subject-matter of claim 1 is novel over the prior art as required by Article 52(1) in combination with Article 54 EPC.

5. *Inventive Step*

5.1 The closest prior art is disclosed in D2. The Board holds the embodiment of figures 3 and 4 as detailed in column 12, line 31, to column 14, line 13 of D2 to be the most relevant starting point for assessing inventive step. The dual slide block mechanism of D3, in that it has separate circular slide blocks sleeved on a non single crankshaft, is further removed from the present invention.

5.2 Figures 3 and 4 show a double cylinder internal combustion engine in "V" configuration with a dual crank circular slide block mechanism formed by two identical circular slide blocks (link pieces 119,120) fixed together about the eccentric opening of each at a 180° angle (see figures 4,4b) which rotatably supports the single crankshaft (via its eccentric pin 121; figure 3a). Both circular slide blocks are rotatably mounted in the circular opening of a displacement member 117 or 118 of a respective piston (figures 4,4a to 4c). Either of the displacement members 117, 118 serves as a dynamic balance sliding piece in accordance

with the claim, and slidably reciprocates within the sliding track formed by the cylinder body.

This embodiment does not include a "thrust converting means" as does the separate, alternative embodiment of figure 2 of D1, contrary to the Appellant's submissions. This is in any case immaterial to the issue of inventive step, as claim 1 does not exclude this feature.

5.3 As noted above, the engine of claim 1 differs from this prior art in that it is arranged in *I form*, i.e. with its cylinders extending along the same axis, and has a *double acting* piston and in that the DBSP is not part of an acting piston.

The DBSP thus serves the *exclusive* purpose of providing dynamic balance, i.e. as a dedicated unit separate from the acting pistons. A dual crank circular slide block mechanism can in this manner also be applied to a double cylinder engine with double acting piston to improve its balance. The technical problem to be solved can be formulated accordingly, namely as improving balance in a double cylinder internal combustion engine in I-form with a double acting piston.

5.4 The claimed solution is neither known from nor obvious in the light of the cited prior art. The general teaching of D2 can be said to reside in arranging cylinders and circular slide blocks such that like cylinders (i.e. single or double acting) balance each other via their linked slide blocks. In figure 6 two perpendicularly arranged single cylinders are thus balanced, while in figures 3 and 7 pluralities of

angularly distributed double acting cylinders are so balanced. In this sense the above teaching can be said to be "symmetric". A similar "symmetric" teaching can also be derived from D3 (though in a constructionally different context) where the two identical double acting cylinders balance each other via their separate slide blocks.

The claimed invention in its application of a *dual* slide block mechanism to an engine with a *single* double acting cylinder by balancing it (via the slide blocks) with a functionally distinct component effectively breaks the "symmetry" of the above teachings. The Board holds this to lie beyond the knowledge and abilities of the skilled person, also when taking account of that person's common general knowledge.

5.5 In the light of the above, the Board concludes that the claimed invention meets the requirements of Article 52(1) with Article 56 EPC.

6. As the claimed subject-matter is moreover manifestly technical in nature, and thus not excluded from patentability, and is also clearly industrially applicable, the Board concludes that the subject-matter of claims 1, 5 and 9 meets all the requirements of Article 52(1) EPC.

Order

For these reasons it is decided that:

1. The decision under appeal is set aside.

The case is remitted to the first instance with order to grant a patent on the basis of the documents indicated under section III.

The Registrar The Chairman

G. Magouliotis M. Ceyte