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D E C I S I O N
of 28 November 1994

Case Number: T 0306/90 - 3.2.4

Application Number: 82303680.1

Publication Number: 0071361

IPC: F02F 3/02

Language of the proceedings: EN

Title of invention:

Pistons for internal combustion engines

Patentee:

AE PLC

Opponents:

MAHLE GMBH

Metallgesellschaft AG, Frankfurt/M

Headword:

-

Relevant legal provisions:

EPC Art. 56

Keyword:

"Inventive step (yes)"

"Closest state of the art"

Decisions cited:

T 0219/83, T 0002/83

Catchword:

-



Case Number: T 0306/90 - 3.2.4

D E C I S I O N
of the Technical Board of Appeal 3.2.4
of 28 November 1994

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Decision under appeal: Decision of the Opposition Division of the
European Patent Office dispatched on 20 March 1990
revoking European patent No. 0 071 361 pursuant to
Article 102(1) EPC.

Composition of the Board:

Chairman: R. E. Gryc
Members: M. G. Hatherly
M. Lewenton

Summary of Facts and Submissions

I. On 10 April 1990 the Appellant (Proprietor) filed an appeal against the decision of the Opposition Division to revoke European patent No. 0 071 361 (resulting from application No. 82 303 680.1) dispatched on 20 March 1990. The appeal fee was paid on 9 April 1990 and the Statement of Grounds of Appeal was received on 23 July 1990.

II. The Opposition Division held that the Grounds for Opposition mentioned in Article 100(a) EPC prejudiced the maintenance of the patent having regard to the following documents:

D4: US-A-4 178 899

D8: Technisches Handbuch, Karl Schmidt GmbH,
Neckarsulm, Ausgabe 1967, pages 69 and 70

D9: EP-A-30 399 and

D11: US-A-1 864 384

III. With the Statement of Grounds the Appellant filed in particular a second request for amendment comprising new pages 4 to 7 of the description and new sheets 1/4 to 4/4 of drawings.

In reply Respondent I contended that the piston according to the invention differed from the piston known from D9 only by the following features:

"a chamfer (8) being provided on at least one of the upper and lower edges of each second bearing surface (15) to provide hydrodynamic lubrication over the associated second bearing surface."

IV. The following documents played a part also in the appeal proceedings:

D1: DE-A-1 450 320
D6: DE-A-2 625 191
D7: DD-A-74 992
D12: FR-E-86 284
D13: US-A-2 705 667 and
D14: US-A-4 274 372

V. Oral proceedings, held on 28 November 1994, were attended by the Appellant and Respondent I (Opponent I).

The duly summoned Respondent II (Opponent II) did not appear. In accordance with Rule 71 (2) EPC the proceedings were continued without him.

During the oral proceedings, the Appellant, for his main request, submitted an amended Claim 1 reading as follows:

"A piston for an internal combustion engine comprising a crown (2), a pair of gudgeon pin bores defined by respective gudgeon pin bosses (6), first and second bearing surfaces (4, 5) on each side of a plane including the piston axis and the gudgeon pin bore axis, each said first bearing surface (4) being toward the crown end of the piston (1) and extending only partially around the piston, and each said second bearing surface (5) extending only partially around the piston (1), the first and second bearing surfaces being formed as segments of a cylinder (4, 5) with the lower edges of the first and the upper and lower edges of the second bearing surfaces lying in respective planes normal to the piston axis, reinforced flanged struts (7) extending normal to the axis of the gudgeon pin bores from each gudgeon pin boss (6) towards both sides of the plane

including the piston axis and the gudgeon pin bore axis, said struts (7) each having an end portion at one of said sides of the piston, each said second bearing surface (5) extending between the ends of two of said struts to cantilever said second bearing surface (5) from the gudgeon pin bosses, the lower edge of each first bearing surface being spaced from the upper edge of the associated second bearing surface by an axially and circumferentially extending window, and a chamfer (8) being provided on at least one of the upper and lower edges of each second bearing surface (5) to provide hydrodynamic lubrication over the associated second bearing surface (5)."

VI. The Appellant argued in the appeal proceedings that Claim 1 of the main request clearly defines a strutted piston but that the piston according to D9 is not a strutted piston and so cannot be the state of the art closest to the invention. The combination of features of the Claim defines a piston with small but adequately lubricated load transferring skirt surfaces to reduce frictional losses during piston reciprocation.

Respondent I (Opponent I) argued in the appeal proceedings that the closest prior art is in fact represented by D9. Even if the document does not explicitly mention struts, they are in fact present, as indeed are nearly all the other claimed features. Chamfers for lubrication purposes are well known so that the claimed piston is lacking in inventive step. The piston would also be obvious were one to start from the piston of D13.

Respondent I left the oral proceedings before the Board delivered the decision.

Respondent II (Opponent II) made requests in the appeal proceedings but did not put forward arguments.

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

as the **main request** on the basis of:

- Claims: 1 to 4 submitted in the oral proceedings;
- Description: pages 1 to 3 submitted in the oral proceedings; and
pages 4 to 7 of the second request for amendment filed with the letter of 19 July 1990; and
- Drawings: sheets 1/4 to 4/4 (Figures 1 to 4, 5A and 5B) filed with the letter of 19 July 1990 for the second request for amendment;

and as the **auxiliary request** on the basis of Claim 1 of the main request with the following wording added:

- "... the first and second bearing surfaces extending around the piston by no more than 45° to either side of a plane including the piston axis and normal to the gudgeon pin bore axis ...".

Respondents I and II both requested that the appeal be dismissed.

Reasons for the Decision

1. The appeal is admissible.

2. *Amendments - main request*

The Board makes no objection under Article 123 EPC to the present version of the patent documents according to the main request.

3. *Novelty - main request*

After considering the documents brought forward in the appeal proceedings the Board considers that none of them discloses a piston with all the features of Claim 1 of the main request. Novelty was moreover not disputed in the appeal proceedings by the parties.

4. *Closest prior art - main request*

4.1 It is the established jurisprudence of the Boards of Appeal that the objective assessment of inventive step has to be preceded by the determination of the technical problem which the invention addresses and solves, and that the technical problem is to be formulated in the light of the closest state of the art.

Therefore, in order to apply this approach for objectively assessing inventive step, it is essential to establish which is the closest prior art.

4.2 At least in mechanical embodiments the closest prior art must be unequivocally and clearly defined, at least for those constructional elements which are important for the claimed invention with which the closest prior art is being compared (see T 570/91, not published).

Before a person skilled in the art can ascertain the disadvantages of a particular prior art arrangement in order to define objectively the problem to be solved, he must know the specific construction of that arrangement, particularly the specific constructional elements which are important for the claimed invention, otherwise right from the start speculative elements enter into the consideration which is to end in the formulation of the objective problem to be solved. In other words, it is doubtful that an objective problem can be formulated if the person skilled in the art starts from an arrangement which is not clearly defined (see T 248/85, OJ EPO 1986, 261) and which, in order to be able to be considered as a starting point, needs to be completed with additional features which have to be selected from a number of undisclosed possibilities.

In the present case the starting point therefore should be a piston whose specific construction is clearly defined, without needing to interpret or to add certain features.

- 4.3 The invention concerns, not a conventional fully skirted piston, but a so-called strutted piston, that is a piston with bearing surfaces of smaller dimensions than a full skirt and carried on struts. Whereas the gudgeon pin bosses of a fully skirted piston tend to separate when the skirt takes up forces, the struts of a strutted piston extend normal to the gudgeon pin bosses so that the latter are not subjected to bending forces. In a strutted piston, the limited arcuate extent of the skirt portions and their spaced support on the struts allow said portions to readily adapt to the cross-sectional shape of the cylinder or liner. However, because the bearing area is smaller with a strutted piston than with a fully skirted piston, lubrication of the bearing area becomes more critical.

Because of the basic differences between the piston types, the Board considers that the correct starting point for assessing the inventive step of the invention (i.e. the closest prior art) must be a strutted piston and not a fully skirted piston. Accordingly, contrary to Respondent I's opinion, the Board finds that the person skilled in the art would not start from the piston according to D9 when designing the inventive piston because the piston of D9 does not resemble a strutted piston but is a modification of a fully skirted piston.

- 4.4 The piston of D9 has set back gudgeon pin bosses 4 (see Figure 2) which is common practice to prevent these areas jamming against the cylinder due to the increased expansion of these areas compared to the remainder of the skirt caused by the gudgeon pin boss areas containing more metal than the skirt. The result is that the lower part 3 of the skirt does not contact the engine cylinder wall in the region of the gudgeon pin bosses so that the second or lower bearing surfaces do not extend wholly around the piston.

However since in D9 there is absolutely no mention of "struts", neither explicitly nor implicitly, and there is no underneath plan view of the piston showing how the connections of the lower part 3 of the skirt to the gudgeon pin bosses 4 look, the specific construction of the piston remains ambiguous and cannot be described with any certainty as being a strutted one.

- 4.5 Moreover to be recognised as that closest to the invention a particular prior art item should at least be concerned with a similar use to that of the invention and should require the minimum of structural and functional modification to arrive at the invention.

This is not the case with the piston according to D9 which furthermore differs essentially from the piston of Claim 1 in the following respects:

- 4.5.1 Compared to the concept of the piston according to the invention, that of the piston known from D9 seems to be different in so far as its bearing surfaces are not flexible, whereas those of strutted pistons normally are flexible.

Indeed D9 specifically states that the lower part 3 of the skirt comprises a stiffening collar 7 which is connected to the gudgeon pin bosses 4 (see Figure 1 and page 7, line 32 to page 8, line 1) implying that the connecting pieces or struts are not stiffened by use of a flange (which would also make technical sense for piston shape adaptation during engine operation).

- 4.5.2 While the strut according to the invention is normal to the gudgeon pin boss, this cannot be unequivocally derived from D9 whose piston might equally have curved connecting pieces i.e. tending to be circumferential.

- 4.5.3 In the piston of document D9 a transverse slot 5 is disposed approximately on the level of the gudgeon pin bosses 4 (see Figure 2 and page 7, lines 27 to 30) in order to prevent direct propagation of a deformation between the top and bottom edges of the piston skirt. Moreover to decrease the skirt surface area between said edges, see page 5, lines 1 to 5, the slot 5 is arcuately widened upwardly and downwardly from the piston skirt supporting areas 6' (the areas transferring forces between the cylinder and the piston) towards the gudgeon pin bosses 4 (see Figure 2 and page 7, lines 30 to 32) and the arcuate edges adjacent the straight edges of the narrow slot 5 tend to sweep the oil film on the cylinder surface aside of the supporting areas. While the slot

must of course run around the piston skirt to separate top from bottom, the piston skirt supporting areas 6' remain as large as possible, the gap therebetween consisting merely of the narrow slot 5. On the other hand, in a strutted piston, as can be seen from Figure 1 of the patent under discussion, also the piston skirt supporting areas are made as small as possible in both the circumferential and the axial directions.

4.5.4 The gap at the piston skirt supporting areas 6' between the lower edge of the upper skirt part 2 and the upper edge of the lower skirt part 3 is narrow and, in the opinion of the Board, can better be described as a slit or slot ("Querschlitz" or transverse slot 5, see page 7, line 29) than as a window which is the term used in Claim 1 of the main request.

Although chamfers are well known in the piston art, D9 does not disclose or hint at a lubrication providing chamfer.

In the piston according to the present invention both the window and the chamfer are important to provide lubrication of the reduced size piston skirt supporting areas. The difference between a slot and a window is significant because the gap at the piston skirt supporting areas must be large enough for sufficient oil to be thrown through to lubricate said reduced size surfaces. In the piston according to D9 the gap need not be as large as a window and the chamfer is unnecessary because the piston skirt supporting areas are kept as large as possible, the skirt being removed only in the unloaded areas towards the gudgeon pin bosses.

In view of all the aforementioned reasons the Board considers that D9 cannot represent the closest prior art.

4.6 Of the strutted pistons available in the appeal proceedings, the Board considers that closest to the present invention to be the piston according to D13 with arcuate skirt sections 20 supported by struts 21 joined to posts 10 receiving the gudgeon pin (see Claim 1 and Figures 3 and 4). The struts 21 are relatively stiff resiliently flexible struts (see page 5, line 128) and the skirt sections are flexible so that they maintain substantially full engagement with the cylinder wall when expanded by heat (see page 2, lines 107 to 111).

5. *Differentiating features, problem and solution - (main request)*

5.1 The piston defined in Claim 1 of the main request differs from that known from the closest prior art disclosed in D13 essentially by

- each of the skirt sections 20 of the known piston being replaced by two skirt sections, one above the other and with an axially and circumferentially extending window therebetween;
- each strut being a reinforced flanged strut and extending normal to the axis of the gudgeon pin bores from the respective gudgeon pin boss to the respective second bearing surface; and
- a chamfer on at least one of the upper and lower edges of each second bearing surface to provide hydrodynamic lubrication over the associated second bearing surface.

5.2 The problem to be solved when starting from the piston according to D13 can be seen as being to improve the piston construction and so that it can weigh less. The Board is satisfied that this problem can be solved by

the absence of the central zones of the known skirt sections and by the struts of the inventive piston being lighter than the known struts 21 extending continuously from well below to well above the gudgeon pin openings 14. The reduction in size of the lubricated area by omission of the central zone which reduces the oil film frictional forces is permitted by the provision of firstly a window between the bearing surfaces which allows oil to be thrown into the right places between said surfaces and secondly a chamfer which forces oil over the second bearing surfaces.

6. *Inventive step - main request*

6.1 When starting from the closest prior art, namely the piston disclosed by D13, the Board does not see that the teaching of any of the other documents in the appeal proceedings would lead the skilled person to perform such modifications as would be necessary to arrive at the piston defined in Claim 1 of the main request.

The fact that features defined in said claim can be found individually in different prior art documents means only that the person skilled in the art would have at his disposal all the means needed to arrive at the present invention and thus the possibility to realise it. However it does not mean that without hindsight or good reason to do so the skilled person would make the precise selection of features needed to arrive at the present piston or would combine the selected features in the specific manner according to the invention (see decision T 2/83, OJ EPO 1984, 265).

6.2 In particular the Board does not consider that the skilled person would (as opposed to merely could) omit the central recessed zone 28 of each skirt section in the piston of D13 because the recessed zone described in

column 5, lines 18 to 21 performs the essential function of maintaining a film of oil on the cylinder wall. Furthermore, even though the recessed zone might be considered as optional since it is first mentioned in dependent Claim 2 of D13, it must be remembered that its omission would merely result in a skirt section of uniform diameter, the same length as the existing skirt section 26 to 28 and continuous in the axial direction rather than resulting in a piston having a window between the end zones as required by the Claim 1 of the main request.

6.3 Although chamfers are known on fully skirted pistons to improve lubrication e.g. from D8 and D11, there is no disclosure in the prior art in the appeal proceedings of a lubrication improving chamfer on the reduced area skirt portions of a strutted piston in combination with a lubrication providing window between upper and lower skirt portions. The chamfers provided on the piston of D4 (see Figure 1) create an oil film over a much greater extent of the piston surface with resultant greater friction than in the present invention.

6.4 Moreover the struts defined in Claim 1 of the main request (reinforced flanged struts extending normal to the axis of the gudgeon pin bores from the respective gudgeon pin boss to the respective second bearing surface) are not an obvious modification of those disclosed by D13 which are so formed as to provide radial yieldability at their junctures with the skirt sections, namely struts having a substantially flat outer portion disposed substantially parallel to the wrist pin axis, and a curved inner portion (see D13, column 3, lines 72 to 74).

- 6.5 As far as the pistons disclosed by documents D1, D6, D7 and D12 are concerned, they have bearing surfaces at only one level i.e. no first (upper) bearing surface and the Board cannot see therefore that their teachings could lead the skilled person in the direction of the invention.
- 6.6 As regards D9, firstly despite the fact that some of the features defined in Claim 1 of the main request can be found in D9 and other features can be found in other documents of the prior art and secondly even assuming that the skilled person started from this - the wrong - starting point, the changes to be made to the piston according to D9 in order to arrive at a piston satisfying Claim 1 of the main request are extensive and the Board sees no pointers in the documents towards the specific construction of the present invention. To argue that the skilled person would select from the prior art only those features needed for the changes while disregarding the remainder has to be considered as being the result of an ex post facto analysis.
7. The subject-matter of Claim 1 of the main request thus involves an inventive step in the meaning of Article 56 EPC.
8. The patent may therefore be maintained amended based on this independent Claim of the main request, dependent Claims 2 to 4 which concern preferred embodiments of the piston according to Claim 1, the amended description and the amended drawings. The Board considers it appropriate in this specific case to define the subject-matter of Claim 1 in a one-part form since to divide the claim using the disclosure of D13 would necessitate changes which would make the claim more difficult to understand.

9. *Communication under Rule 58(4) EPC*

Although Respondent II did not attend the oral proceedings, he had had the opportunity to comment on the version on file for the main request prior to the oral proceedings. That version differs from the present version in which the patent is to be maintained only by Claim 1 being in the one-part form with corresponding amendments in the description and by the acknowledgement of D13 in the description. Thus Respondent II had the opportunity to comment on essentially the version in which the patent is to be maintained.

Although Respondent I was no longer present in the oral proceedings when the Board delivered its decision, he had been present during the discussion of the amendments which were to be made and he had agreed that their implementation could be left to the Appellant and the Board.

Therefore a communication under Rule 58(4) EPC is unnecessary (see decision T 219/83, OJ EPO 1986, 211).

10. Since the Appellant's main request can be granted, it is not necessary to consider his auxiliary request.


Order

For these reasons it is decided that:

1. The decision under appeal is set aside.

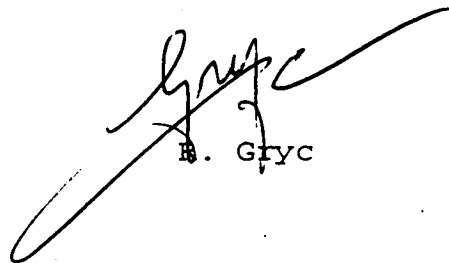
2. The case is remitted to the first instance with the order to maintain the patent on the basis of the main request, see section VII.

The Registrar:



N. Maslin

The Chairman:



B. Gryc

