BESCHWERDEKAMMERN DES EUROPÄISCHEN PATENTAMTS

BOARDS OF APPEAL OF THE EUROPEAN PATENT OFFICE

CHAMBRES DE RECOURS DE L'OFFICE EUROPEEN DES BREVETS

Publication in the Official Journal yes / No

File Number: T 513/88

Application No.: 82 901 140.2

Publication No.: 77 349

Title of invention: Manufacture of pistons

Classification: B23P 15/10; C22F 3/00; C22F 1/04

D E C I S I O N
of 24 April 1991

Proprietor of the patent: AE PLC

Opponent: MAHLE GMBH

Headword:

EPC Article 56 EPC

Keyword: "Inventive step (no)"

Headnote

Europäisches Patentamt | European Patent Office | Office européen des brevets

Beschwerdekammern | Boards of Appeal | Chambres de recours

Case Number : T 513/88

D E C I S I O N
of the Technical Board of Appeal
of 24 April 1991

Appellant : (Proprietor of the patent)
AE PLC
Cawston House Cawston
Rugby Warwickshire CV22 7SB (GB)

Representative :
Knott, Stephen Gilbert et al
MATHISEN, MACARA & CO.
European Patent Attorneys
The Coach House, 6-8 Swakeleys Road
ICKENHAM, UXBRIDGE UB10 8BZ (GB)

Respondent : (Opponent)
MAHLE GMBH
Pragstrasse 26-46
Postfach 50 07 69
D-7000 Stuttgart 50 (DE)

Representative :

Decision under appeal :
Decision of the Opposition Division of the European Patent Office dated 4 August 1988 revoking European patent No. 0 077 349 pursuant to Article 102(1) EPC.

Composition of the Board :

Chairman : G. Szabo
Members : J. du Pouget de Nadaillac
M. Schar-Schuppisser

Summary of Facts and Submissions

I. This appeal lies from the decision of the Opposition Division dated 4 August 1988 revoking for lack of inventive step the European patent No. 77 349, granted in response to European patent application No. 82 901 140.2.

The opposition was based, inter alia, on:

D1: Mahle-Kolloquium Mai 1973, pages 20-31
D2: DE-A-28 35 332
D3: DE-C-29 30 552
D4: DE-A-2 027 649
D5: Handbuch der Fertigungstechnik, Band 1 "Urformen", page 908.

II. The appeal was lodged by the Appellant (Proprietor of the patent) on 4 October 1988. The appeal fee was paid two days later and the Grounds of Appeal were filed on 6 December 1988, accompanied by two sets of claims, as main and auxiliary requests, respectively.

III. Independent Claim 1 of the main request reads as follows:

"A method of manufacturing a piston of an aluminium, or an aluminium alloy material for a combustion engine or a reciprocating compressor and having a recessed crown or bowl in the crown and an edge region between the recess or bowl and a radially outer peripheral portion of the crown, characterised by the step of, either before or after the machining of the recess, applying to the edge region, or a part of the piston which is to form the edge region an alloying material, laser or electron beam alloying said edge region, or said part, to produce an edge region or

Independent Claim 5 differs from Claim 1 in that the words "alloying material" are replaced by the terms "dispersion-hardening material". The other Claims 2 to 4 and 6 to 8 are dependent on Claim 1 or 5.

IV. Independent Claim 1 of the auxiliary request is a combination of Claims 1 and 2 of the main request and reads as follows:

"A method of manufacturing a piston of an aluminium or an aluminium alloy material for a combustion engine or a reciprocating compressor and having a recessed crown or bowl in the crown and an edge region between the recess or bowl and a radially outer peripheral portion of the crown, characterised by the step of, either before or after the machining of the recess, applying to the edge region, or a part of the piston which is to form the edge region, an alloying material which forms, with the material of the piston, an alloy which is better able to resist operating conditions in an engine cylinder than the material of the piston, and then heating with a laser or electron beam, the alloying material and the piston material beneath the alloying material to form an annular edge region of alloy extending around the edge region or around the part of the piston which is to form the edge region, said alloy being formed from a combination of the piston material and the alloying material."

Independent Claim 4 of this request is identical to Claim 5 of the main request. Claims 2, 3 and 5 to 7 are dependent upon Claim 1 or 4.

V. The further tentative amendments, to which the Appellant has reserved his right, consist in replacing "alloying material" by "manganese" in both Claims 1, or deleting Claims 1 to 4 in the main request or Claims 1 to 3 in the auxiliary request.

VI. In a communication dated 8 January 1990, the Board expressed the provisional view that it was doubtful whether the subject-matter of Claims 1 of either the main or the auxiliary request involved an inventive step in view of Documents D1, D2 and D4, and that the same might apply to amended claims tentatively suggested by the Appellant.

VII. In his reply and in his statement of Grounds, the Appellant argued as follows:

The problem to be solved by the present invention relates to a method for reinforcing the combustion bowl edge of a piston. This problem was already envisaged in documents D1 and D4, which both teach the reinforcement of the edge by an electro-deposited alloy.

However, there is a main difference between the deposit or build-up process shown in these two documents and the alloying process of the present invention: Documents D1 and D4 disclose, in fact, an armouring of piston regions with an added layer. That is to say, there is the application of a material onto the piston surface, which is already an alloy and gives in itself the required properties. In contrast, with the present invention, the applied material is not claimed as an alloy, but as a material which forms an alloy in situ in combination with the basic piston material, and only this combination gives the required effect. The present invention necessitates smaller quantities of added material than the process according to documents D1 and D4.

Of course, in all these different methods, zones with a mixture of the applied material and of the basic piston material are provided, but these mixed zones are only transition zones between the piston material and the overlayed material in the prior art, whereas they form the new edge surface of the bowl of the piston in the invention.

Thus, the difference between Claim 1 and the prior art according to documents D1 and D4 lies in the use of a method of heating and, above all, in the character of the applied material, resulting, therefore, in a different process, namely an alloying process instead of the cladding process of said prior art. Since different materials, i.e. an alloy and pure aluminium, are recommended for the ring grooves and for the combustion bowl entrance in document D4, this document gives the teaching that different reinforcements are required regarding these regions. It also shows that an alloy is not the best protection for the bowl edge. Moreover, the reinforcement of piston ring grooves serves a completely different purpose (wear resistance) in comparison to the improvement of a combustion bowl edge (resistance to high temperatures to avoid cracks).

For all these reasons, the skilled man is unlikely to turn to documents D2 and D3, which are only concerned with the reinforcement of the ring grooves, whilst the combustion bowl edge is not even mentioned. Manganese is cited in document D2, however, only for the purpose of strengthening the grooves, and not for heat resistance purposes. Furthermore, document D3 is not concerned with the improvement of the piston surface, since it describes the "alloying" of a supporting frame or transition zone between the piston material and the wear-resistant layer of the ring grooves.

The Respondent maintained his earlier objections to the maintenance of the patent.

VIII. The Appellant requests that the impugned decision be set aside and the patent be maintained in amended form on the basis of the main request, or one of the auxiliary requests.

The Respondent requests the appeal to be dismissed.

Reasons for the Decision

1. The appeal is admissible.

2. The two embodiments claimed, as granted, in a single independent Claim 1 are now, in each set of claims, claimed separately and independently. Such a modification is not inconsistent with Article 123(3) EPC. The amendment, in fact a clarification, introduced at the end of Claim 1 of the main request is supported by the lines 5 and 6 of page 8 of the description, as filed. The amendment brought in Claim 1 of the auxiliary request has its support in the originally filed Claim 12. Manganese was also mentioned in the original description, at the end of page 7. All these amendments follow, consequently, the requirements of Article 123(2) and (3) EPC.

3. **Closest prior art**

The two documents D1 and D4 deal with the reinforcement of the combustion bowl edge of a piston. The object of document D4 is to improve the known method of deposit

welding or "armouring", in which a light metal material having the required properties is welded on a region of the piston. Different regions are mentioned, - among others the combustion bowl edge. The improvement is obtained by the provision of a mixed zone between the basic piston material and the light metal built-up welded material, which forms a continuous transition from one material to the other, ensuring thereby a strain-free joint between both materials. The method is performed by applying a plurality of built-up layers. For the bowl combustion edge, which requires heat resistance, pure aluminium is proposed, whereas particular aluminium alloys are indicated for the ring grooves and the gudgeon pin bore, respectively. The welding means are not mentioned.

Document D1 gives a full account of different methods for reinforcing the parts of a piston, which are particularly subjected to high mechanical or temperature stresses. The same parts of the piston, as above, are enumerated and various methods are discussed, like the dispersion-hardening process for pistons of an aluminium alloy material or the electron beam treatment to grain refine the piston material. The reference points out that this last method does not change the chemical composition of the piston material and that, as a consequence, the required properties cannot be obtained. The use of alloys, which have the properties corresponding to the requirements, is then suggested and a method is described, in which an alloy, brought in the form of a wire on the combustion bowl edge, is welded by means of a TIG torch, in such a way that the applied material is melted with the basic piston material.

The differences in the teaching of documents D1 and D4 are slight. The reference D1 is more exhaustive relative to

the different methods, teaching inter alia the dispersion-hardening technique and the use of charge carrier beams. Moreover, it emphasizes the idea of modifying the composition of the basic piston material to reinforce certain parts thereof. This prior art appears, consequently, to be the closest one.

4. In view of this prior art, the technical problem to be solved by the contested patent is to provide a method for the reinforcement of the edge region between the combustion bowl and the radially outer peripheral portion of the piston crown.

5. The problem is solved by the new following features of Claim 1 of the main and auxiliary requests:

(a) The applied material is an alloying material, that is to say a material which forms an alloy with given properties, when combined with the basic piston material.

(b) The carrier charge beam is a laser or electron beam.

According to the description, the alloying material, for example manganese, is applied to the edge in the form of a powder, slurry or wire, and the beam is directed onto the material and melts said material and the piston material beneath, so that both materials are mixed together.

6. Such a method is known from the document D2, however, solely in relation with piston ring grooves to improve the wear resistance of their sides.

In this document, it is stated that, before the machining of the piston surface, the auxiliary material, which can be one of the elements vanadium, chromium, manganese and

so on, is brought in the form of a wire onto the surface part of the piston ring groove to be treated and is then melted, preferably by means of an electron beam, together with the piston material and mixed therewith to obtain the required alloy.

7. In this technical field, the skilled person in the art with regard to the problem to be solved is the materials specialist. As shown by documents D1 and D4, he customarily uses various methods and applies them to those parts of the piston, which are normally subjected to different kinds of stresses, i.e. the high temperatures for the combustion bowl edge or the mechanical stresses for the ring grooves and the gudgeon pin bore. Accordingly, it forms also part of his normal activities to select in accordance with the method chosen the appropriate material, which satisfy the particular requirements of the piston part to be treated (see document D4, which shows such a selection at the end of its description). Thus, the specialist, when looking for a solution for a specific part of the piston, cannot be unduly confined to this part in his thinking and is presumed to relate the same to others within the context of the more general problem of reinforcing parts of the piston. This practice is confirmed by the original description of the contested patent, which indicates that the invention can be used on parts of the piston other than the bowl edge.

8. Reading document D1, the skilled person would have already learnt of methods which change to some extent the composition of the piston for reinforcing parts of it, and of using a carrier charge beam. Document D2 is very close, since it fulfills these conditions. Furthermore, it describes a method very similar to the welding method of document D1, bringing also the auxiliary material in the form of a wire onto the piston part to be treated and

heating it by means of a carrier beam, so that the skilled person would have been led to take its teaching into consideration and to try to apply it for the combustion bowl edge, coming thereby to the subject-matter of the present claims. No technical difficulty can be seen or was suggested by the Appellant, in the given circumstances.

9. As seen above, it must have been clear for the man skilled in the art that different auxiliary materials were to be applied, because of the different requirements for the bowl edge and for the ring grooves. The Appellant is right, insofar he argued that, because of the sole difference in the used auxiliary materials, different "treatments" were taught by document D4 for these piston parts; nevertheless this document teaches the same method for both parts. Also the fact that document D4 suggests the use of pure aluminium and not an alloy for the combustion bowl edge should not lead the expert away from thinking of using alloys, particularly when document D1 recommends alloys for the said edge with the same method. It should further be pointed out that the scope of both Claims 1 embrace pistons made of pure aluminium, so that the expert, when considering the problem to be solved, knows that, necessarily, he has to look for materials with other properties, namely alloys.

10. Since document D2 discloses manganese as applied material, the introduction of this feature in the Claim 1 of each request will not add any non-obvious character to the content of these claims. For all these reasons, no inventive step can be seen in the subject-matter of Claim 1 of either the main request or the auxiliary one, even when amended by specifying the auxiliary material to be manganese.

11. As to independent Claim 5 in the main request and Claim 4 in the auxiliary request, the same arguments apply. In the original description of the contested patent, the dispersion-hardening process is shown as quite equivalent to the alloying process. It is common knowledge (see reference D5) to use a dispersion-hardening method for improving aluminium alloys, which are subjected to high temperatures, in particular in connection with alumina as auxiliary material. Further document D1, page 23, describes this technique for reinforcing pistons of an aluminium alloy material, particularly for heat resistance reasons, and alumina is mentioned as auxiliary material, as it is the present case. Thus, having in view the teaching of document D2, it is also obvious to apply this technique by means of a laser or electron beam. The additional and last proposal of the Appellant to consider these claims as main claims replacing others is, therefore, to be rejected.

Order

For these reasons, it is decided that:

The appeal is dismissed.

The Registrar: The Chairman:

N. Maslin G. Szabo

02103