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D E C I S I O N
of 9 November 1994

Case Number: T 0525/92 - 3.2.2

Application Number: 86106598.5

Publication Number: 0205893

IPC: C22F 1/04

Language of the proceedings: EN

Title of invention:
Bearing materials

Patentee:
AE PLC

Opponent:
(01) Metallgesellschaft AG
(02) Glyco - Metallwerke B.V. & Co. KG

Headword:
-

Relevant legal provisions:
EPC Art. 56

Keyword:
"Inventive step - (yes)"

Decisions cited:
-

Catchword:
-

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Case Number: T 0525/92 - 3.2.2

D E C I S I O N
of the Technical Board of Appeal 3.2.2
of 9 November 1994

Appellant I: (Opponent 01)
Metallgesellschaft AG
Reuterweg 14
Postfach 10 15 01
D-60271 Frankfurt am Main (DE)

Appellant II: (Opponent 02)
Glyco Metallwerke B.V. & Co. KG
Stielstraße 11
D-65201 Wiesbaden (DE)

Representative:
Mehler, Klaus, Dr rer.nat.
Patentanwälte
Dr Fuchs, Dr Luderschmidt,
Dr Mehler, Dipl.-Ing. Weiß
Abraham-Lincoln-Straße 7
D-65189 Wiesbaden (DE)

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

Representative:
Crux, John A.
European Patent Attorney
T & N plc
Bowdon House
Ashburton Road West
Trafford Park
Manchester M17 1RA (GB)

Decision under appeal: **Interlocutory decision of the Opposition Division of the European Patent Office dated 7 April 1992 concerning maintenance of European patent No. 0 205 893 in amended form.**

Composition of the Board:

Chairman: H. Seidenschwarz
Members: P. Dropmann
J. Van Moer

Summary of Facts and Submissions

I. Two Notices of Appeal were filed against the interlocutory decision of the Opposition Division dated 7 April 1992 finding patent No. 0 205 893 in amended form to meet the requirements of the EPC.

The Opposition Division held that the grounds of opposition mentioned in Article 100(a) EPC did not prejudice the maintenance of the patent as amended.

II. Claim 1 of the patent in amended form reads as follows:

"A process for the production of an aluminium-based bearing material having a steel back and a composition lying within the following ranges expressed in weight per cent; 9 to 13 tin, 1 to 3 copper, 2 to 10 silicon and remainder aluminium apart from incidental impurities, the method comprising the steps of producing a desired alloy composition in suitable form and bonding the alloy to steel characterised by raising the temperature of the bonded material to a temperature of at least 425°C but less than 525°C and wherein the aggregate time to heat to temperature and the dwell time at temperature lies within the range from 60 seconds to 10 minutes and subsequently cooling the bonded material at a cooling rate of at least 50°C/minute for at least part of the temperature drop to ambient temperature."

III. Oral proceedings were held on 9 November 1994.

IV. The Appellants (Opponents) requested that the decision under appeal be set aside and the patent revoked.

V. The Respondent (Proprietor of the patent) requested that the appeals be dismissed.

VI. The Appellants essentially argued as follows:

The subject-matter of Claim 1 did not involve an inventive step (Article 56 EPC) in the light of documents EP-A- 0 131 428 (D1) and DE-B-2 043 676 (D2) or in the light of documents D1 and D3 (Aluminium-Taschenbuch, ed. Aluminium-Zentrale, Düsseldorf, 14th edition, Aluminium-Verlag Düsseldorf, 1983, pages 44, 45, 131 to 134 and 493 to 498).

Document D1 disclosed an aluminium based alloy for use as a bearing lining on a steel backing which alloy could have the same composition as the alloy mentioned in the contested patent and possessed improved fatigue strength, compatibility and conformability. Faced with the problem of further increasing the fatigue strength of this bearing material, the skilled person would apply the short time/high temperature/fast cooling/heat treatment step known from document D2 since this document was concerned with the improvement of fatigue resistance of aluminium-based bearing alloys containing silicon.

Likewise, a combination of the teachings of documents D1 and D3 was obvious and would lead to the process according to the disputed patent. Temperature, duration, and cooling rate of the claimed heat treatment were common knowledge in the field as proven by document D3. In particular, page 493, Table 8.16 of document D3 disclosed that the duration of solution treatment of clad semi-finished products lay in the range of minutes.

VII. In contesting the Appellants' arguments, the Respondent submitted that the claimed process involved an inventive step. The Appellants' argumentation was based on hindsight. The process according to the contested patent relied on the supersaturation of aluminium by copper and

required only a short term heat treatment, the long term heat treatment mentioned in the patent being only optional. This process was fundamentally different to the process known from document D2 which relied on precipitation hardening based on a reaction between magnesium and silicon and thus required a two-stage heat treatment comprising a short term/high temperature and a long term/low temperature heat treatment. Therefore, it was not obvious to take one single feature, i.e. the solution treatment step, out of the process according to document D2 and apply it to the totally different alloy known from document D1.

Reasons for the Decision

1. The appeals are admissible.

2. *Novelty*

The Board is satisfied that the process as claimed is novel over each document mentioned during the proceedings. Indeed, none of the documents teaches a process having all the features specified in Claim 1. Since novelty was not disputed, more detailed arguments need not be given.

3. *Inventive step*

3.1 Document D1 represents the state of the art which, due to the composition of the aluminium-based bearing alloy and the properties of the bearing material, is closest to the subject-matter of Claim 1. The prior art portion of Claim 1 is based on this state of the art. Document D1 discloses alloys for use as a bearing lining on a steel backing comprising, by weight, 8 to 35% tin, 0.2

to 3% copper, 1 to 11% silicon, the balance being aluminium. It is further known from this document that such bearing materials, after bonding the alloys to the steel backing, possess fatigue strength superior to alloys AlSn20Cu1 and AlSi11Cu1 (cf. document D1, page 4), improved compatibility over AlSn20Cu1 when used in conjunction with cast-iron and steel shafts (cf. pages 5 and 6), good conformability (cf. pages 2 and 3), good dirt embedability (cf. pages 2 and 3) and bore broachability (cf. page 9).

3.2 In the light of the state of the art known from document D1, the objective technical problem underlying the present invention is to be seen as further improving the fatigue strength of the bearing material of document D1 without causing deterioration of the bond between the alloy layer and its steel backing by possible formation of intermetallic compounds (cf. patent specification, page 2, lines 48 to 55). This problem slightly differs from that stated at page 2, lines 37 to 40 of the patent specification, the reason being that a part of the problems indicated there has already been solved by document D1.

3.3 In accordance with the features of the characterising portion of Claim 1, the technical problem is solved by a particular short term/high temperature/fast cooling/heat treatment of the bonded material known from document D1. In view of the results achieved in Example 1 without and after fluidised bed treatment (cf. in particular Table 1 and page 5, lines 28 to 34 of the patent specification), the Board is satisfied that the fatigue strength is substantially improved by the process of the present invention. It is noted that this improvement is due to the short term solution treatment and cooling of the bonded material, no subsequent precipitation hardening being necessary to achieve this result, although such an

additional long term precipitation treatment may optionally be undertaken (cf. page 3, lines 46 to 51 of the patent specification and dependent Claim 6 of the patent in amended form) and may lead to a further increase of hardness (cf. Examples 4 and 5).

3.4 The question to be answered is whether, as alleged by the Appellants, documents D2 or D3 give any hint that the problem indicated above would be solved in the way specified in Claim 1 of the contested patent in amended form.

3.5 The Board accepts the Appellants' argument that the skilled person, faced with the problem of further increasing the fatigue strength of the bearing material known from document D1 without impairing the bond between the alloy layer and the steel backing, would take document D2 into consideration, because this document is concerned with a similar problem of improving hardness and fatigue resistance without causing deterioration of said bond (cf. document D2, column 2, lines 58 to 68).

However, document D2 does not suggest the solution specified in Claim 1. Indeed, this document teaches that the hardness and fatigue strength of a specific silicon- and cadmium-containing aluminium-based bearing alloy bonded to a steel backing can be improved by adding 0.05 to 0.15% copper and 0.1 to 2% magnesium and by applying, subsequent to the bonding of the alloy to the steel backing, a two-stage heat treatment comprising the steps of heating the bearing material to a temperature of 480 to 525°C for a period of at least 15 seconds but less than 5 minutes, quenching the material in a liquid having a maximum temperature of 40°C, forming the bearing and precipitation hardening the bearing for a period of 10 hours at a temperature of 175°C.

Thus, the teaching of document D2, although disclosing a short term/high temperature/fast cooling/thermal processing step similar to that mentioned in the contested patent, necessitates, in addition, both the incorporation of magnesium into the alloy and a precipitation hardening step, i.e. a second heat treatment step, in order to improve fatigue resistance.

In contrast to this teaching, the process according to Claim 1 of the contested patent achieves the increase of fatigue strength of the bearing alloy known from document D1 without the addition of magnesium to the alloy and without any precipitation hardening step, although such a step is optional. The claimed process requires only the short term/high temperature/fast cooling/thermal treatment step to achieve the desired object. Since document D2 does not contain any hint that magnesium may be absent and that said short term heat treatment step is sufficient to increase the fatigue strength, the Board takes the view that document D2 does not render the process according to Claim 1 obvious. For the same reason, a combination of the teachings of documents D1 and D2 would not lead to the subject-matter of Claim 1.

The Appellants' argument that the skilled person can clearly derive from document D2 that the increase of the fatigue strength is solely due to the short term heat treatment step, which causes the magnesium, copper and a portion of the silicon to go into solid solution with the aluminium, and the subsequent rapid quenching to preserve a condition of supersaturation, rather than to both the short term and the precipitation hardening steps and that, therefore, it would be obvious to the skilled person to transfer the short term heat treatment step to the alloy of document D1, has no basis in document D2. In fact, document D2 does not indicate any

increase of hardness or fatigue strength, which is associated with hardness, due to the solution heat treatment and subsequent quenching. The hardness figures stated in document D2 are either those before the solution heat treatment or those after the two-stage heat treatment comprising precipitation hardening. The Appellants' argument, therefore, cannot be accepted by the Board.

In addition, the Appellants argued that the skilled person knew that, for solving the problem he was faced with, magnesium, which had to be present in an amount of 0.1 to 2% in the alloy according to document D2, had properties similar to copper, which was present in an amount of 0.2 to 3% in the alloy according to document D1, and that, according to page 157 of the book "Werkstoffe für Gleitlager", edited by R. Kühnel, second edition, Springer 1952, copper and magnesium belonged to those elements which served to increase the strength of aluminium-based alloys. However, as pointed out by the Respondent (cf. point VII above), there is a fundamental difference as to the strengthening mechanisms in the contested patent and in the process known from document D2. Whilst the contested patent relies on supersaturation of aluminium by copper and therefore requires only a short term/high temperature/heat treatment followed by rapid cooling in order to improve the fatigue strength, the process according to document D2 relies on precipitation hardening due to a reaction between magnesium and silicon and thus requires a two-stage heat treatment comprising both a short term/high temperature/heat treatment followed by rapid cooling and a long term/low temperature/heat treatment for precipitation. Hence, document D2 cannot suggest the process according to Claim 1 of the amended patent.

3.6 Furthermore, in the Board's judgement, the claimed process is not obvious in the light of a combination of documents D1 and D3. It is true that solid solution hardening by supersaturation achieved by solution treatment and subsequent rapid cooling belongs to the common knowledge of the skilled person. However, contrary to the Appellants' allegations, it was not known or obvious in the art prior to the priority date that it is essential in the process for the production of an aluminium-based bearing material having a steel backing that the rate of heating to the solution temperature is high and the dwell time at that temperature is sufficiently short so that, as specified in Claim 1, the aggregate time to heat to temperature and the dwell time at temperature lies within the range from 60 seconds to 10 minutes. In particular, such short overall heating time is not suggested by Table 8.16 at page 493 of document D3, since the maximum duration of the solution treatment of clad semi-finished products indicated there is at least 20 minutes and there is no hint that a range from 60 seconds to 10 minutes is essential.

3.7 The process according to Claim 1 thus cannot be derived in an obvious manner from the state of the art mentioned during the proceedings and, therefore, involves an inventive step in accordance with Article 56 EPC.

4. The subject-matter of Claim 1 is, therefore, patentable having regard to Articles 52(1), 54 and 56 EPC.

Dependant Claims 2 to 8 define particular embodiments and meet likewise the requirements of the EPC.

Order

For these reasons it is decided that:

The appeal is dismissed.

The Registrar: The Chairman:

S. Fabiani H. Seidenschwarz