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**Datasheet for the decision
of 4 February 2010**

Case Number: T 0931/08 - 3.2.08

Application Number: 02716355.9

Publication Number: 1354971

IPC: C22C 38/00

Language of the proceedings: EN

Title of invention:

Bearing material

Applicant:

JFE Steel Corporation, et al

Opponent:

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Headword:

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Relevant legal provisions:

-

Relevant legal provisions (EPC 1973):

EPC Art. 56

Keyword:

"Inventive step (no)"

Decisions cited:

-

Catchword:

-



Case Number: T 0931/08 - 3.2.08

DECISION
of the Technical Board of Appeal 3.2.08
of 4 February 2010

Appellant:

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Representative:

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Decision under appeal:

**Decision of the Examining Division of the
European Patent Office posted 13 February 2008
refusing European application No. 02716355.9
pursuant to Article 97(1) EPC.**

Composition of the Board:

Chairman: T. Kriner
Members: R. Ries
A. Pignatelli

Summary of Facts and Submissions

- I. The appellant (applicant) lodged an appeal against the decision of the examining division dated 13 February 2008 to refuse European patent application No. 02716355.9.

The appeal was received at the European Patent Office on 11 April 2008 and the appeal fee was paid on the same date. The statement setting out the grounds of appeal was received on 18 April 2008.

- II. In an official communication, the Board gave its provisional view on the case in particular with the respect to the document

D1: US-A-5 960 250.

- III. Oral proceeding before the Board took place on 4 February 2010.

The appellant requested that

- the decision under appeal be set aside and
- the patent be maintained on the basis of the claims 1 to 3 according to the main request, or the single claim according the auxiliary request, both filed with letter dated 4 January 2010.

Moreover, the appellant requested that the obvious mistake in Table 1 of the application as filed be corrected.

IV. Independent claim 1 reads as follows:

"A bearing material having a component composition in which C: 0.95 to 1.10 mass%, Si: 0.15 to 0.70 mass%, Mn 1.15 mass% or less, Cr: 0.90 to 1.60 mass%, and P: 0.025 mass% or less are contained, S and O, that are elements forming nonmetallic inclusions, are contained at S: 0.025 mass% or less and O: 0.0012 mass% or less, optionally containing 0.10 to 0.25 mass% of Mo and/or 0.0010 mass% or less of Sb and the rest comprises Fe and incidental impurities, wherein in the material, the maximum diameter of the oxide-based nonmetallic inclusion is more than 10 μm , but 15 μm or less in an inspection area: 320 mm^2 , while the number of oxide-based nonmetallic inclusions having an equivalent circle diameter of 3 μm or more is 250 or less in the inspection area: 320 mm^2 , and furthermore AlN is contained at 0.020 mass% or less, and/or the number of sulfide-based nonmetallic inclusions having a thickness of 1 μm or more is 1,200 or less in the inspection area: 320 mm^2 ."

The single claim of the auxiliary request corresponds to claim 1 of the main request with the amendment that the number of oxide-based nonmetallic inclusions having an equivalent circle diameter of 3 μm or more is restricted to **220** or less in the inspection area: 320 mm^2 .

V. The appellant's arguments are summarized as follows:

Contrary to the technical disclosure of document D1, the bearing material according to the invention needed to fulfil the conditions for the oxide inclusions of

(A) the size (the maximum diameter of the oxide based non-metallic inclusions was $> 10 \mu\text{m}$ to $15 \mu\text{m}$) and (B) the number (the oxide based inclusion having an equivalent circle diameter of $\geq 3 \mu\text{m}$ / 320mm^2 inspection area was 250 or less) in order to obtain a roller bearing material exhibiting a rolling contact fatigue life B_{10} of more than 50×10^6 . Both features (A) and (B) and in particular the combination of these features were not explicitly described in document D1. The claimed bearing material was therefore novel over the teaching of document D1.

The importance of adhering to features (A) and (B) was supported by the Reference Figure enclosed with letter of 4 January 2010 and including the results of the claimed bearing material and the test data given in Tables 1 and 2 of D1. The Reference Figure clearly showed the advantage of the invention that a B_{10} life of 50×10^6 or more was reliably obtained without the burden of reducing the maximum diameter of the oxide inclusions to less than $10 \mu\text{m}$, as proposed in D1.

Although claim 1 of document D1 possibly could lead to conclude that a suitable bearing material was obtained with oxide inclusions larger than $10 \mu\text{m}$, the general description of D1 provided clear evidence for the skilled person not to work above a maximum diameter of $10 \mu\text{m}$ of the oxide based inclusions. This finding was confirmed in D1, column 5, lines 15 to 32 by the statement that the rolling contact fatigue life B_{10} was significantly impaired rather than improved when the maximum diameter of the oxide inclusions was larger than $10 \mu\text{m}$. Consequently, document D1 pointed away from the claimed bearing material.

As to feature (B), document D1 concluded with regard to Figures 1 and 2 that the oxide size was a more adequate index affecting the rolling contact fatigue life than the oxide number (see D1, column 1, lines 58 to 62). The fact that D1 did not present further studies on the number of oxide inclusions of $> 3 \mu\text{m}/ 320 \text{mm}^2$ implied that the oxide number was considered as a minor factor.

Given that the restrictions on the oxide inclusions according to features (A) and (B) were neither disclosed nor obvious from the disclosure of document D1, designing the bearing material claimed in the present application was only possible on the basis of hindsight.

Consequently, the subject matter of claim 1 of the main request and also of the auxiliary request which further restricted the number of oxide inclusion $>3 \mu\text{m}$ to 220 or less was novel and involved an inventive step.

Reasons for the Decision

1. The appeal is admissible.
2. *Main request*
 - 2.1 Novelty

Document D1 discloses a bearing material

(i) consisting of:

C: 0.95 to 1.10 mass%

Si: 0.15 to 0.70 mass%

Mn: 1.15 or less mass%
Cr: 0.90 to 1.60 mass%
P: 0.025 or less mass%
S: 0.025% or less mass%
O: 0.0012 or less mass%
optionally
Mo: 0.10 to 0.25 mass%
Sb: 0.0010 or less mass%
Fe: balance

and incidental impurities,

(ii) the material containing AlN of 0.020 mass% or less
and

(iii) wherein the number of the sulphide based non-
metallic inclusions having a thickness of 1 μm or more
is 1,200 or less in the inspection area of 320 mm^2 (see
D1, claims 1 to 3).

As regards the features (i) to (iii) the known bearing
material and that claimed in the application are
therefore identical.

Turning to the claimed maximum diameter of the non-
metal oxide inclusions of >10 to 15 μm (feature (A)),
the appellant's argument is correct that document D1
does not specify a particular limitation for the
maximum size of the oxide inclusions (see e.g. D1,
claim 1). When looking at the examples of bearing
material given in D1, Table 1, it is however to be
noted that the majority of the "material based on this
invention" exhibit a maximum diameter of the oxide
inclusions between 10.6 μm and 13.8 μm and thus falls
within the range claimed for the oxide base particle
size in the application. Particular reference is made
in this context to samples No. 6 and 12 in Table 1 of

D1 which, in addition to feature (A), satisfy also the claimed technical features (i) to (iii) identified above. Document D1 in its broadest aspect therefore encompasses diameters of oxide inclusions greater than 10 μm and less than 15 μm which result in an acceptable B_{10} life. The appellant's argument that D1 did not specify the presence of oxide inclusions having a size of >10 to 15 μm or even discards bearing steels comprising such oxide inclusions is therefore unfounded.

Consequently, also with respect to the maximum diameter of the oxide inclusions (feature (A)), a technical difference is not discernible between the bearing material known from D1 and that claimed in the application under consideration.

- 2.2 However, document D1 does not explicitly disclose the claimed proviso that the number of oxide-based inclusions $\geq 3 \mu\text{m}$ should be ≤ 250 per inspection area: 320 mm^2 (feature (B)).

The subject matter of independent claim 1 is therefore novel over the disclosure of document D1.

3. *Problem to be solved*

- 3.1 Starting from document D1 as representing the closest prior art, the problem underlying the present application resides in providing a bearing steel that exhibits an improved and long B_{10} life and which can be manufactured without a restriction to the refining process and without increasing the manufacturing cost, e.g. by expensive ladle refining for further reducing the oxygen and nitrogen content of the melt (see the

application as filed, page 3, last paragraph to page 4, line 1).

According to the application, page 15, lines 1 to 14, this problem is solved by controlling the number of oxide-based non-metal inclusions of $\geq 3 \mu\text{m}$ within the range of ≤ 250 in an observation area of 320 mm^2 without the need for reducing their maximum diameter simultaneously to an extreme small size, such as $10 \mu\text{m}$ or less.

4. *Inventive step*

The appellant's argument is not disputed that according to the technical teaching of document D1, a pronounced benefit in terms of improvement of the B_{10} -life can be achieved if the maximum diameter of the oxide inclusion is $10 \mu\text{m}$ or less. This argument is supported by the explanations given in D1, column 2, lines 58 to 61, column 3, lines 18 to 22; column 5, lines 15 to 32; column 8, lines 53 to 65 and Figures 2, 4 and 5.

- 4.1 However, the technical information of document D1 goes beyond this. In addition to the other technical information of D1 referred to above, Figure 1 of document D1 clearly and unambiguously teaches the skilled reader that the smaller the number of oxide inclusion oxide-based inclusions $\geq 3 \mu\text{m}$ is in an inspection area: 320 mm^2 , the better are the fatigue properties (see D1, column 1, lines 58 to 60 and 63 to 67; column 5, lines 39 to 42). Starting from D1 and faced with the problem of further increasing the B_{10} life of a bearing steel, the skilled person is taught by document D1 that, in addition to the beneficial

effect of limiting the AlN content, the number of sulphide inclusions and the maximum diameter of the oxide inclusions to 10 μm or less, the B_{10} life can be significantly improved by reducing the number of oxides $> 3 \mu\text{m}$. Simply by analysing Figure 1 of D1, there is a clear hint for the person skilled in the art to reduce as much as possible the number of oxide inclusions having an equivalent circle diameter of $\geq 3 \mu\text{m}$ in the inspection area of 320 mm^2 . Contrary to the appellant's point of view that D1 fails to present further studies on that point, this general technical teaching is given in document D1, even if this finding is not further heightened in the description. In the light of the general object of minimizing as much as possible the number of oxide inclusions, the setting of an upper limit for this number of oxide inclusions such as < 250 is of no inventive merit.

4.2 The appellant's pointer to the Reference figure and its allegation of an ex-post-facto analysis when evaluating the technical disclosure of document D1 cannot change this conclusion. A skilled person looking for technical assistance would consider and put into practice all the technical information that is given in document D1 to improve the B_{10} life of a bearing material, irrespective of whether or not the specific technical information is presented individually in the form of a Figure or is discussed later in further detail in the description or the examples of document D1.

4.3 Hence the subject matter of claims 1 of the main request does not involve an inventive step.

5. *Auxiliary request*

The same line of argument is valid for claim 1 of the auxiliary request which differs from claim 1 of the main request by restricting the number of oxide based inclusion of 3 μm or more to 220 or less. Consequently, the subject matter of claim 1 of the auxiliary request also lacks an inventive step for the same reasons.

6. Given this situation, there is no need to deal with the appellant's request for correcting an obvious mistake in Table 1 of the application.

Order

For these reasons it is decided that:

The appeal is dismissed

The Registrar:

The Chairman:

V. Commare

T. Kriner