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D E C I S I O N
of 4 March 2004

Case Number: T 0753/02 - 3.2.1

Application Number: 92905063.1

Publication Number: 0571481

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Language of the proceedings: EN

Title of invention:
Bearings

Patentee:
DANA CORPORATION

Opponent:
Miba Gleitlager Aktiengesellschaft
GLYCO-METALL-WERKE Glyco B.V. & Co. KG
KS Gleitlager GmbH

Headword:
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Relevant legal provisions:
EPC Art. 123(2), 83, 84, 54, 56

Keyword:
"Added subject-matter (no)"
"Fresh ground invoked for the first time in appeal proceedings - not admitted"
"Novelty (yes)"
"Inventive step (yes)"

Decisions cited:
T 0472/00, G 0010/91, T 0012/81

Catchword:
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Beschwerdekammern | Boards of Appeal | Chambres de recours

Case Number: T 0753/02 - 3.2.1

D E C I S I O N
of the Technical Board of Appeal 3.2.1
of 4 March 2004

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Decision under appeal: **Decision of the Opposition Division of the European Patent Office posted 4 June 2002 revoking European patent No. 0571481 pursuant to Article 102(1) EPC.**

Composition of the Board:

Chairman: S. Crane
Members: Y. A. F. Lemblé
G. E. Weiss

Summary of Facts and Submissions

I. The appeal is directed against the decision of the Opposition Division to revoke the European patent No. 0 571 481. The Opposition Division decided that claim 1 according to each of the patent proprietor's main request and first and second auxiliary requests did not meet the requirements of Article 123(2) and (3) EPC and that the subject-matter of claim 1 according to each of the third to sixth auxiliary requests lacked inventive step (Article 100(a) and (b) EPC).

II. The following evidence cited during the opposition proceedings played a role in the appeal:

D2: DE-C-28 53 724

D3: "A Preliminary Study of the Electrodeposition of Tin and Non-metallic Particles", Plating and Surface Finishing, May 1985, pages 120-125

D4: "Nach Verwendungszweck geordnete, galvanisch erzeugte Dispersionsschichten", H. Roßwag, Maschinenmarkt Würzburg, 1978, Seiten 2014-2018

D28: EP-A-0 205 893

D36: Hardness testing of overlays

III. During the oral proceedings held on 4 March 2004 the appellant requested that the decision to revoke the patent be set aside and that the patent be maintained on the basis of the main request submitted at the oral proceedings, or in the alternative, on the basis of the

second to fifth auxiliary requests filed with letter dated 29 January 2004. All three respondents (opponents I, II and III) requested that the appeal be dismissed.

IV. Independent Claim 1 according to the main request reads:

"1. Use for a plain journal bearing of an internal combustion engine of a composite material comprising a bearing material on which is deposited an overlay coating, the overlay coating comprising a soft metal matrix which has dispersed therein a second phase of a hard, non-metallic material, said hard, non-metallic material having a Vickers hardness (Hv) of at least 300, the bulk of said overlay coating being constituted by the soft metal matrix,
the composite material being characterized in that the matrix of the soft metal overlay coating is selected from the group consisting of: tin-based; lead-based; and, cadmium-based metals and in that the hard second phase consists of alumina particles and in that said soft metal and said hard particles are deposited by electro-codeposition and whereby the ability to embed dirt particles in said electro-codeposited overlay coating comprising the matrix selected from tin-based; lead-based; and, cadmium-based metals having the dispersed phase of alumina therein is not adversely affected compared with that of the soft metallic phase of the matrix."

V. In support of their request of dismissal of the appeal, the respondents argued essentially as follows:

The amendments made in claim 1 gave rise to clarity objections as well as to doubts whether there was a basis in the originally filed documents for the additions made in the last part of claim 1.
More particularly, the precise meaning of the term "tin-based; lead-based; and, cadmium-based metals" remained unclear in spite of the fact that this topic was already dealt with in the earlier decision of the Board, T 472/00.

The introduction in the last lines of claim 1 of the features that the dirt particle embeddability of the overlay remained unaffected by the dispersed phase of alumina was not immediately and unambiguously derivable from the content of the application as originally filed. For an unprejudiced reader, the introduction of this new property in combination with the specific choice of alumina did not appear to be compatible with the global teaching of the granted patent, reference being made, for example, to dependent claim 9. The now claimed unaltered embeddability, which was, by the way, neither defined in the patent by appropriate parameters nor by the specific composition of the soft metal matrix, raised the questions of the conditions under which this effect could be technically achievable. The newly added emphasis on this property had taken such an importance that it should be examined by the Board under the aspect of sufficiency of disclosure as a new opposition ground (Article 100(b) EPC).

The subject-matter of claim 1 was not novel over the prior art shown in D4. Table 4 on page 2015 of this document already disclosed a layer consisting of the

combination of a soft lead matrix with hard particles of alumina.

Alternatively, the subject-matter of the claim was also not novel over prior art document D2. Although claim 1 had allegedly been delimited with respect to this document, the latter not only disclosed an overlay coating comprising a soft metal matrix which had dispersed therein hard non-metallic particles as defined in the preamble of claim 1, but the passage of column 5, lines 50-55 also taught the choice of lead, cadmium or tin for the metals forming the soft metal matrix and of alumina for the hard particles of the second phase. There was no necessity for the hard particles to be an oxide of one of the metals forming the soft matrix. As mentioned in column 6, lines 1-2 of D2, the claimed composition could be obtained by the use of two targets, one ejecting the metal base and the other ejecting the alumina obtained by complete oxidation of an aluminium target. Another possibility would be to proceed by explosion of a wire of cadmium, tin or lead, the alumina particles being obtained by a complete oxidation of a slight amount of aluminium also contained into the wire.

In compliance with the Guidelines C-III, 4.7b, the fact that the claimed composition was produced by means of a process (electro-codeposition) which differed from that of D2 (cathodic sputtering, wire explosion) did not render the composition novel over that obtained in D2. The feature that "said soft metal and said hard particles are deposited by electro-codeposition" was merely indicative of the possibility for the bearing overlay to be produced by codeposition but was not able

to confer novelty to a composition which was known in all other respects.
The last part of claim 1 which referred to the retained embeddability did not define a distinguishing feature of technical significance. The property of dirt embeddability was relative and not directly measurable. It relied on the inherent softness of the metal matrix which constituted the bulk of the overly coating. The addition of hard particles to such a matrix did not necessarily lead to a degradation of dirt embeddability. The claimed retained embeddability applied to the matrix of D2 as well.

The subject-matter of claim 1 did not involve an inventive step over the prior art.

Although D2 was not in itself directed to the deposition of the overlay by an electrochemical route, it nevertheless mentioned this possibility in column 4, lines 26-47. The skilled person would therefore take notice of technological advances in that field. D4 cited in table 4 on page 2015 the combination of a soft lead or cadmium matrix with hard particles of alumina obtained by electrocodeposition. In the same way, the scientific publication D3 studied on page 123, left hand column, second paragraph the galvanic codeposition of tin and silicon carbide and came to the findings that the microhardness of the codeposits was similar to that of a pure tin coating and that wear resistance was improved. Since silicon carbide, alumina and other non-metallic particles were all mentioned in one breath in this prior art (see table 2, on page 123 of D3 or table 4 on page 2015), the skilled person would expect the same advantages from the combination of a tin

matrix with particles of alumina. The combination D2 with D4, or D2 with D3, would therefore lead in an obvious way to the subject-matter of claim 1.

An alternative line of argumentation was to start from the bearings discussed in the introductory part of the description of the patent (page 2, lines 10-18). These bearings consisted of a bearing material on which an overlay coating was deposited by electrodeposition, said overlay comprising a soft metal alloy based on lead or tin (D28: page 2, lines 17-20). As mentioned on page 2, lines 25-29 of the patent, the problem with this type of overlay was that they suffered from a poor wear resistance. Confronted with the technical problem mentioned in the patent, i.e. to increase wear resistance and retain the dirt embeddability of the known overlays, the skilled person would find an obvious solution in the incorporation of particles of a hard material, such as silicon carbide, within the tin based metal, as mentioned in D3, page 123, left hand column, second paragraph. According to this, such codeposits had an increased wear resistance connected with an unchanged micro-hardness, i.e. the quality of dirt embeddability was retained. Since, as mentioned above, the same advantages could be expected from alumina which is a non metallic hard particle equivalent to silicon carbide, the combination D28 with D3 would lead to the subject-matter of claim 1 in an obvious manner.

VI. The appellant's submissions made in writing and at the oral proceedings, insofar as they are relevant to the present decision, can be summarised as follows:

The feature relative to the retained ability to embed dirt particles was disclosed in the patent as granted and in the originally filed application document.

There was no reason to examine the question of embeddability under the aspect of sufficiency of disclosure Article 100(b) EPC.

The subject-matter of claim 1 was new and involved an inventive step over the prior art disclosed in D2, D3 and D4.

The effect achieved by the incorporation of alumina particles in the metal base matrix could be seen from Table 2 and from the histogram of Figure 2 of the patent. The addition of alumina particles considerably improved the wear resistance of the overlay, a problem which had been exacerbated in recent years by the use of cast-iron crankshafts which were inherently more abrasive in nature than the steel shafts which preceded them. Table 2 showed that total weight loss after 140 hours of wear testing of an overlay comprising lead-10%tin was reduced from 15mg to 6mg, i.e. an increase in wear resistance of 250%. Three-dimensional measurements of the surface finish of the tested hardened steel shaft showed that the Ra value had been reduced from 0.32 to 0.20 micrometers, and the peak value (Rp) from 1.02 to 0.73 micrometers. The alumina particles were believed to exert a gentle polishing action on the associated shaft journal to render that journal less abrasive to the soft overlay.
This increase in wear resistance had been achieved whilst maintaining the hardness of the galvanically electro-deposited coating at the low level of the basic

matrix material. D36 showed a table of different overlay alloy compositions, based on lead, one of which had an addition of 1 wt% alumina. It was to be noted that both of the lead-10%tin alloys, with or without alumina, still had hardnesses in the range from 10 to 12 Hv.

The present invention flew directly in the face of the teaching of D2 which sought to increase wear resistance by means of deposition by cathodic sputtering. This increase in wear resistance was however connected with an increase of hardness due to dispersion hardening caused by the very small particles of alumina formed in the metal matrix in statu nascendi. In the example given in column 5, lines 48-65 of D2, an overlay produced by cathodic sputtering and comprising an AlSn20Cu metal matrix which had dispersed therein a second phase of hard alumina particles was described. The hardness of this overlay was 130 Hv, to compare with a Vickers hardness of 35 Hv for the continuously cast AlSn20Cu metal alloy.

Consequently, the teaching of the invention was not anticipated by D2. The person skilled in the art would not combine D2 with D3 or D2 with D4 since there was absolutely nothing to be gained in so doing.

Reasons for the Decision

1. *Admissibility of the amendments Article 123(2) and (3) EPC*

1.1 Claim 1 of the main request comprises all of the features of claim 1 which was held by the Board in decision T 472/00 to meet the requirements of Article 123(2) and (3) EPC. The claim additionally specifies that the claimed composite material is restricted to the use for the plain journal bearing of an internal combustion engine. This use has been originally disclosed in page 1, second paragraph and page 3, first and third paragraphs of the application as originally filed.

1.2 The introductory part of the description of the application mentions the deposition, on known plain journal bearings, of an overlay coating comprising a soft metal alloy based on lead, tin or cadmium (page 2, line 12-15 and claim 3). These prior art composite bearings suffer from a poor wear resistance (page 3, second paragraph). Thus, in accordance with page 3, third paragraph of the application, the object of the invention is "to provide a material for a bearing overlay which is more wear resistant than known overlay materials but which retains the desirable characteristics of conformability and dirt embeddability of known overlays".

After the definition of the inventive concept of an overlay coating comprising a soft metal matrix which has dispersed therein a second phase of a hard non-metallic material, page 5, lines 1-3 reads: "Because the bulk of the overlay consists of the soft metallic phase, the ability to embed dirt particles is not adversely affected". In the above mentioned global context of this application, it is implicit at this point that the sole component which could affect dirt

embeddability is the hard non-metallic second phase. Alumina is cited later in the "Example 1" and on the following pages as the sole component of the hard second phase.

Consequently, the features of the last lines of claim 1, that the ability of the claimed overlay to embed dirt particles remains unaffected by the dispersed phase of alumina, is directly and unambiguously derivable from the content of the application as originally filed.

The argument of the respondents that the connection between the claimed embeddability and the specific choice of alumina was not consistent with the global teaching of the granted patent is an argument which does not apply for the purpose of the admissibility of the amendments.

2. *Clarity (Article 84 EPC)*

In T 472/00 the Board held that the person skilled in the art would have no difficulty in understanding the term "tin-based; lead based and cadmium based". This topic must be considered as "res judicata" and cannot be revisited.

3. *Admissibility of the new opposition ground under Article 100(b) EPC*

In a case where a patent has been opposed under Article 100(a) EPC on the ground that the claims lack novelty or lack an inventive step in view of documents cited in the notice of opposition, the ground of insufficiency of disclosure based upon Article 100(b)

EPC is a fresh ground for opposition and accordingly may not be introduced into the appeal proceedings without the agreement of the patent proprietor (see Opinion G 10/91 of the Enlarged Board of Appeal, OJ 1993, 420).
In the present case, since the patent proprietor did not agree to the introduction of this fresh ground, the Board has decided not to admit this ground into the appeal procedure.

It would be different if the objection of insufficiency of disclosure arose out of amendments made to the subject-matter of the claim but this is not the case here since granted claim 1 already specified that "the ability to embed dirt particles is not adversely affected".

Moreover, there is no necessity to define the claimed unaltered embeddability by appropriate parameters or the specific composition of the soft metal matrix, since this property was well known, and therefore technically achievable, by the prior art bearings mentioned in the introductory part of the patent. The composition of the soft metal matrix has simply to remain the same as that of the prior art, i.e. a soft metal alloy based on lead, tin or cadmium and deposited by electrodeposition (see also D28: page 2, lines 17-20).

4. *Novelty*

4.1 According to the appellant claim 1 has been delimited with respect to prior art document D2, the

characterizing portion comprising the following distinguishing features:

(i) the matrix of the soft metal overlay coating is selected from the group consisting of: tin-based; lead based and cadmium based metals,

(ii) the hard second phase consists of alumina particles;

(iii) said soft metal and said hard particles are deposited by electro-codeposition

(iv) the ability to embed dirt particles in said electro-codeposited overlay coating comprising the matrix selected from tin-based; lead-based; and cadmium-based metals having the dispersed phase of alumina therein is not adversely affected compared with that of the soft metallic phase of the matrix.

4.2 Referring to Guidelines C-III, 4.7b the respondents submitted that the fact that the claimed composition was produced by means of a process (electro-codeposition) which differed from that of D2 (cathodic sputtering) did not render the composition novel over that obtained in D2.
The Board does not share this view.

Guidelines C-III, 4.7b cited by the respondents relate mainly to the case where the claimed product is exclusively defined in terms of its process of

manufacture and it is not otherwise possible to distinguish it from the known product, for example in the case of a chemical compound. In the present case, however, the fact that the base metals and the alumina are deposited by electro-codeposition has a technical significance and leads to technical implications.

An important technical limitation that the person skilled in metallurgical electroplating infers from feature iii) is that the presence of aluminium in the claimed overlay is precluded, since it is not possible to deposit aluminium from aqueous solutions which are used for the deposition of lead or tin or cadmium based metals. There is an inherent impossibility for aluminium to deposit simultaneously with the other metals because aluminium is a much stronger reducing agent than lead, tin or cadmium.

It is also important to note that feature ii) of claim 1 requires that the hard particles consist exclusively of aluminium oxide.

In considering novelty, it has therefore to be examined if there is in D2 an explicit or an implicit disclosure of an overlay coating, the bulk of which is constituted by a soft metal matrix selected from the group consisting of: tin-based; lead based and cadmium based metals with the exclusion of aluminium, said matrix having dispersed therein a hard second phase consisting exclusively of alumina particles.

In this respect, the considerations made by the respondents relative to the disclosure D2 are not convincing. The passage cited by them (column 5,

lines 50-55) is a simple list of the metals which could form, alone or in combination, the softer metal matrix (Al, Pb, Cd, Sn, Zn, Ni, Cu). This list is followed by the indication that the hard particles of the second phase are oxides of one or more of those metals.

Owing to the fact that D2 requires that the hard particles be formed in the electrical gas discharge ("elektrische Gasentladung") by oxidation and these just formed ("in statu nascendi") particles be inserted in the simultaneously formed matrix, the skilled person would primarily expect the hard particles to be oxides of one of the metals forming the soft matrix. This interpretation conforms with claim 3 and the preferred mode of implementation of the process described in columns 5-7 of D2. Since aluminium is the sole compound which can lead to alumina by oxidation, this implies the presence of aluminium in the matrix of the overlay, which, as said above, is not compatible with what is claimed in claim 1.

According to page 6 of the letter dated 3 April 2003 of respondent II, the claimed composition could be obtained by the use of two targets, one ejecting the metal base and the other ejecting the alumina by complete oxidation of aluminium. Another possibility would be to proceed by explosion of a wire of cadmium, tin or lead, the alumina particles being obtained by a complete oxidation of a slight amount of aluminium also contained into the wire.

These assertions, which are obviously based on an ex post facto analysis, appear to be very selective as to the choice of the starting materials and highly

speculative as to the possibility of obtaining the claimed composition. They rely on the prerequisite that, during a simultaneous deposition process, the total amount of aluminium would always be completely oxidized while the other base metals would remain intact. Taking into account the explanations given in column 8, lines 38-50 of D2 relative to the possibility of influencing the amounts of oxide in the metal to be sputtered, it seems very unlikely that a skilled person could conciliate these two conflicting requirements in order to come to the claimed composition by using the process of D2.

Consequently, in the light of the above considerations, the claimed combination of a tin-based, lead based or a cadmium based metal matrix and an electro-codeposited second hard phase of alumina particles represents a selection which, according to established jurisprudence of the Boards of Appeal (T 12/81, OJ 8/1992, 296), cannot be considered as disclosed in D2.

Finally, the Board is of the opinion that it is possible to distinguish by an examination of the microstructure of the matrix, e.g. with a microscope or by a scanning electron micrograph (SEM), whether it has been obtained by sputtering or by electro-codeposition. Sputtering ejects the metals as very finely divided particles or even individual atoms. The hard particles should therefore be extremely finely dispersed into a matrix having also individual particles of very small size in the order of a few nanometres. Electro-codeposition instead, leads to much larger deposits in the size range of the micrometer and tolerates the presence of a small number of agglomerated particles up

to 5 micrometers (see claim 7 and page 10, three last lines of the patent application as filed).

It follows from the above considerations that the subject-matter of claim 1 is novel over D2.

4.3 The subject-matter of claim 1 is also novel over D4, since there is no indication in this document of an overlay deposited on a bearing material to be used for the plain journal bearing of an internal combustion engine.

5. *Inventive step*

5.1 The Board has no reason to question the contention of the appellant that the incorporation of alumina particles in the metal base matrix considerably improves the wear resistance of the overlay and that this increase in wear resistance has been achieved whilst maintaining the hardness of the electro-deposited coating at the low level of the basic matrix material, i.e. whilst retaining dirt embeddability and conformability of the known overlays. This contention appears to be adequately supported by the content of the patent (especially Table 2 and the histogram of Figure 2) and by the document D36.

The fact that the hardened steel shaft tested with the overlay of the invention had its surface roughness greatly reduced with the assumption that the alumina particles exert a gentle polishing action on the associated shaft journal to render it less abrasive seems to be an important aspect of the present invention.

5.2 The Board was not convinced by the argument of the respondents I and II that it would be a simple matter to combine the teaching of D2 with D4, or D2 with D3, in order to come to the subject-matter of claim 1.

D3 and D4 are scientific papers presenting general considerations about, respectively, the galvanic deposition of dispersion hardened coatings and the electro-co-deposition of tin with non-metallic particles. Their teaching is only of general interest.

In the section headed "Other Co-deposits" in column 2, page 124 of D3 is merely mentioned the co-deposition of tin with alumina, tungsten carbide and graphite. There is no teaching that such deposits could be of any use whatsoever in a plain journal bearing.
D4 is mainly aimed at increasing the hardness of a metallic matrix by the inclusion of dispersoids. According to page 2014, right-hand column, the size of such non metallic dispersoids is selected so as to fall within the order of magnitude of the precipitations in precipitation hardened alloys. Such small particles sized in the submicron range prevent movement of the dislocations in the material. As a consequence plastic deformation cannot occur until higher stress values are reached. This teaching is entirely at variance with the effect achieved by the particles in the claimed composition.

In table 4 on page 2015 of D4, there is the mere mention of the possibility of combining a lead or cadmium matrix with hard particles of alumina. There is, however, no indication of the properties of such

coatings. Within the global content of D4, the reader would not expect these compositions to fulfil the requirements in respect of dirt embeddability and conformability which are crucial for the bearing overlay of an internal combustion engine.

Furthermore, D2 itself teaches away from depositing the overlay by electrochemical ways. Referring to electrochemical deposition on column 4, lines 26-46, D2 states that the addition of hard particles by galvanic deposal had been tested in attempts to increase the fatigue strength and the wear resistance of plated metal overlays. The results were not adequate and had lead to inferior coatings, the hard particles being too coarse and acting as internal notches under changing loads.

Consequently, there is nothing in the above mentioned documents which could act as incentive for combining them.

5.3 In the opinion of the Board the more serious thread to the patentability of the claimed subject-matter is to be seen in the alternative line of argumentation presented by respondent III, which is to start from the known bearings discussed in the introductory part of the description of the patent (D28: page 2, lines 17-20) and to aim at an increase of wear resistance while retaining the valuable properties of known overlays (conformability, dirt embeddability).

The Board does not, however, share the view of respondent III that the skilled person would find an obvious solution to this problem in the galvanic co-

deposition of tin and hard particles. The arguments of the respondents rely on the assertion that silicon carbide increased the wear resistance of a tin matrix, as mentioned in D3, page 123, left hand column, second paragraph. This assertion is, however, not founded. The passage in question reads: "The micro-hardness of the co-deposits was similar to that of a pure tin coating. However, the ultimate tensile strength of the coatings was slightly lower than that of pure tin. Wear resistance is to be tested and the presence of silicon carbide is expected to have a beneficial effect." The fact that micro-hardness was similar suggests an unaffected dirt embeddability, but whether silicon carbide increases the wear resistance or not, is left open. The last step of the argumentation of respondent III, according to which it would be obvious to replace the silicon carbide by aluminium oxide, crowns a reasoning which can only be motivated by hindsight. Even if it was assumed that silicon carbide gave satisfactory results, why then would the skilled person replace it by aluminium oxide when he/she does not know at all what effect this replacement of the hard particles material would bring about.

5.4 It follows from the above that the subject-matter of claim 1 as granted involve an inventive step (Article 56 EPC).

6. Dependent claims 2 to 6 relate to further developments of the inventive concept disclosed in claim 1 and contain all of the features of claim 1. The above conclusions regarding novelty and inventive step apply equally to these claims which likewise meet the requirements of the EPC.

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 with the following documents:

   - claims 1 to 6 and description according to the main request submitted at the oral proceedings;

   - drawings as granted

The Registrar: The Chairman:

S. Fabiani S. Crane