

**Internal distribution code:**

- (A) [ ] Publication in OJ  
(B) [ ] To Chairmen and Members  
(C) [X] To Chairmen

**D E C I S I O N**  
**of 13 September 1999**

**Case Number:** T 1005/97 - 3.2.1

**Application Number:** 88109225.8

**Publication Number:** 0294813

**IPC:** F16C 33/62

**Language of the proceedings:** EN

**Title of invention:**

Antifriction bearing and alternator incorporating same for use  
in vehicles

**Patentee:**

Nippondenso Co., Ltd.

**Opponent:**

AB SKF

**Headword:**

-

**Relevant legal provisions:**

EPC Art. 56

**Keyword:**

"Inventive step (no)"

**Decisions cited:**

-

**Catchword:**

-



Europäisches  
Patentamt

European  
Patent Office

Office européen  
des brevets

Beschwerdekammern

Boards of Appeal

Chambres de recours

Case Number: T 1005/97 - 3.2.1

**D E C I S I O N**  
**of the Technical Board of Appeal 3.2.1**  
**of 13 September 1999**

**Appellant:** Nippondenso Co., Ltd.  
(Proprietor of the patent) 1-1, Showa-cho  
Kariya-shi  
Aichi-ken (JP)

**Representative:** Ter Meer Steinmeister & Partner GbR  
Mauerkircherstrasse 45  
81679 München (DE)

**Respondent:** AB SKF  
(Opponent) 415 50 Göteborg (SE)

**Representative:** Westman, P. Börje I.  
Göteborgs Patentbyrå AB  
Sjöporten 4  
417 64 Göteborg (SE)

**Decision under appeal:** Decision of the Opposition Division of the  
European Patent Office posted 21 July 1997  
revoking European patent No. 0 294 813 pursuant  
to Article 102(1) EPC.

**Composition of the Board:**

**Chairman:** F. Gumbel  
**Members:** S. Crane  
J.-C. Saisset

## Summary of Facts and Submissions

- I. European patent No. 0 294 813 was granted on 21 September 1994 on the basis of European patent application No. 88 109 225.8.
- II. The granted patent was opposed by the present respondents on the grounds that its subject-matter lacked novelty and/or inventive step with respect to the state of the art (Article 100(a) EPC).

Among the prior art documents relied upon were the following:

- (D2) AT-A-362 807;
- (D3) E. Yajima, T. Miyazaki, T. Sugiyama and H. Terajima, "Effects of Retained Austenite on the Rolling Fatigue Life of Ball Bearing Steels", Trans. JIM, 1974 Vol. 15, pages 173 to 179;
- (D4) W. Spyra, "Über die Abhängigkeit der Wärmeleitfähigkeit des Kugellagerstahls 100Cr6 (SKL) vom Werkstoffzustand", DEW-Technische Berichte, Volume 7, 1967, No. 3, pages 165 to 167;
- (D17) R. C. Drutowski and E.B. Mikus, "The Effect of Ball Bearing Structure on Rolling Friction and Contact Plastic Deformation", Transactions of the ASME, Journal of Basic Engineering, June 1960, pages 302 to 308.

- III. With its decision posted on 21 July 1997 the Opposition

Division revoked the patent.

The reasons given for this decision were that the claims 11 and 9, respectively, according to the main and second auxiliary requests contravened Article 123(3) EPC and the subject-matter of the independent claims according to the first and third auxiliary requests lacked novelty and/or inventive step in comparison with the state of the art documents listed in Section II above.

- IV. An appeal against this decision was filed on 22 September 1997 and the fee for appeal paid at the same time.

The statement of grounds of appeal was filed on 25 November 1997. With this statement the appellants (proprietors of the patent) submitted a new set of claims on the basis of which they requested maintenance of the patent in amended form.

- V. In a communication dated 11 September 1998 the Board stated its preliminary opinion that claim 1 of the new set of claims filed with the statement of grounds contained added subject-matter in contravention of Article 123(2) EPC. With regard to the substantive issue of inventive step the Board pointed to the particular relevance of document R17.

- VI. In response to this communication the appellants filed on 17 March 1999 a new set of claims 1 to 8. These claims correspond to the claims according to the third auxiliary request considered by the Opposition Division. Independent claims 1 and 4 read as follows:

"1. An antifriction bearing having an inner ring, an outer ring and a multiplicity of rolling members arranged therebetween, wherein one of the inner ring and outer ring is a fixed ring and the other is a rotary ring, and wherein said fixed ring is adapted to be subjected to vibration or impact load, **characterized** in that the fixed ring is made of a steel containing up to about 6% residual austenite, measured in a depth of 0.1 or 0.2 mm below the raceway of the ring by conducting a sub-zero treatment between hardening and tempering or by a tempering treatment at a temperature of 250 to 380°C, after hardening heating and hardening cooling."

"4. An alternator for vehicles wherein the rotary shaft (15) of a rotor (18) is rotatably supported by a pair of bearings (13,14) on a frame (10,11) having a stator (12) and a drive pulley (20) is mounted on one end of the rotary shaft projecting outward from the frame, the alternator being **characterized** in that the outer ring of at least the bearing (13) toward the pulley (20) is made of a steel containing up to about 6% of residual austenite, measured in a depth of 0.1 or 0.2 mm below the raceway of the ring."

Dependent claims 2 and 3 and 5 to 8 relate to preferred embodiments of the bearing according to claim 1 and the alternator according to claim 4 respectively.

In support of their request for maintenance of the patent in amended form on the basis of these claims the appellants argued substantially as follows:

Document R17, which was the closest state of the art,

was concerned with the properties of a certain steel material whereas the claimed invention was directed to an antifriction bearing for use in an environment where it was subjected to high vibration or impact load, in particular in a vehicle alternator. The conditions encountered in such an environment were wholly different to those found in measuring instruments, the field of use discussed in document R17. It was these harsh conditions which had to be taken into account when considering the beneficial effects of the low austenite content required by the present independent claims, in particular the avoidance of the generation of martensite and consequential shortening of the life of the bearing. There was no suggestion in document R17 that the steel referred to there could be used to achieve this advantage.

VII. In a second communication dated 22 April 1999 the Board confirmed its negative view concerning the issue of inventive step in respect of document R17. No response from the appellants was received to this second communication.

VIII. With a letter dated 18 June 1999 the respondents argued that the subject-matter of the claims lacked inventive step with regard in particular to document R17. They pointed out that claim 1 made no reference to high vibration or impact loads or to high rotational speeds. With regard to the transformation of residual austenite into martensite under load they argued, with reference to a further prior art document, that this was a well and long known phenomenon.

They therefore requested that the appeal be dismissed

and the revocation of the patent confirmed.

### **Reasons for the Decision**

1. The appeal complies with the formal requirements of Articles 106 to 108 and Rules 1(1) and 64 EPC; it is therefore admissible.
  
2. The contested patent is particularly concerned with problems associated with the shaft bearings of a vehicle alternator. Demand in recent years for weight reduction combined with higher output has led in practice to high rotational speeds in connection with high transverse shaft loading due to increased belt tension to avoid slippage. This combination can in turn lead to excessive heat generation. The basic aim of the claimed invention is therefore to provide a rolling bearing capable of performing well in this environment. The solution offered resides in the reduction by one of two alternative techniques of the amount of residual austenite in the raceway surface of the fixed bearing ring to below about 6%. Accordingly, even if subjected to vibration or impact, the ring is less prone to deformation at its raceway, remains stable in structure and is resistant to structural changes or cracking, with the result that the bearing is usable for a prolonged period of time without the necessity of being made larger in size. The reduced plastic deformation of the raceway leads to a reduction in vibration, frictional force and the generation of heat, cf page 4, lines 36 to 39 and 46 to 49, of the patent specification.

Document R17 discloses the advantages to be achieved with respect to reducing rolling friction and the deformation of a bearing raceway by reducing the retained austenite content of a particular bearing steel (SAE 52100) to a maximum of 3.9%. This bearing steel is equivalent to the bearing steel SUJ2 used in several examples of the claimed invention, see page 5, lines 11 and 12, of the patent specification. It is evident that the austenite level referred to in document R17 must be that in the surface layer of the material otherwise the improvement in frictional properties would not be obtained. Furthermore, in the second paragraph of the right-hand column of page 302 of R17 there is reference to austenite determination of the "surface". According to Example A a steel with 0% retained austenite is obtained by tempering for one hour at 260°C after oil quenching from 843°C. This treatment corresponds to the second alternative stated in present claim 1 for achieving the desired austenite level. According to Example B a steel with 3.9% retained austenite is obtained by sub-cooling the steel after oil quenching for half an hour to -195°C followed by heating for half an hour at 121°C, this sub-cooling and heating cycle being repeated five times. This treatment corresponds to the first of the alternatives stated in the claim.

In the paragraph entitled "Plastic Deformation at High Stress" in the left-hand column of page 306 there is a discussion of the superior properties in this context of the steel of Example B in comparison with a steel having 7.4% retained austenite. On the basis of the information given there it is obvious for the person skilled in the art that the bearing steel structures



with up to 3.9% retained austenite discussed in document R17, which indisputably constitute a steel as defined in present claim 1, are eminently suitable for making one or other or both of the inner and outer rings of a rolling bearing adapted to be subjected to vibration or impact load, since by doing so the amount of plastic deformation of the rings under such load can be minimised and with it the rolling friction.

The Board cannot accept the contention of the appellants that the experimental nature of the findings of documents R17 coupled with the reference therein to measuring instruments as being the particular field of use under consideration would effectively blinker the person skilled in the art to the general applicability of what is being said there, this all the more so given the conventional nature of the SAE 52100 bearing steel being investigated. Furthermore, the argument of the appellants that document R17 does not mention the underlying idea on which the claimed invention is based, namely the avoidance of strain induced martensite generation in the surface of the bearing ring, does not square wholly with the facts, since there is a discussion of this phenomenon in the paragraph bridging the left and right-hand columns of page 306.

The subject-matter of claim 1 therefore lacks inventive step (Article 56 EPC).

3. Having regard to the negative conclusion reached with respect to the subject-matter of claim 1, detailed consideration of the subject-matter of claim 4 is unnecessary. It is to be noted however that claim 4

does not require the low austenite content to have been achieved by any particular treatment, thus potentially embracing a much wider range of bearing steels than does claim 1. Be that as it may, the Board is in any case satisfied that the person skilled in the art would recognise in the low austenite content bearing steel taught by document R17 a material suitable for use in the context of the outer ring of a rolling bearing for a vehicle alternator as defined in claim 4.

**Order**

**For these reasons it is decided that:**

The appeal is dismissed.

The Registrar:

The Chairman:

M. Maslin

F. Gumbel