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Case Number: T 0779/96 - 3.4.1

D E C I S I O N
of 16 November 2001 for correction of errors in the decision of the Technical Board of Appeal 3.4.1 of 14 November 2001

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Decision under appeal: **Interlocutory decision of the Opposition Division of the European Patent Office posted 9 July 1996 concerning maintenance of European patent No. 0 101 552 in amended form.**

Composition of the Board:

Chairman: M. G. L. Rognoni
Members: H. K. Wolfrum
M. K. S. Aúz Castro

Pursuant to Rule 89 EPC, the above-mentioned decision is corrected as follows:

In claim 4, which is intended to recite the same features as claims 13 and 21, the Figure "10" for the lower limit of the amount of R is corrected to "12" to bring the claim into accordance with the wording of said corresponding claims; in claim 20, which is the first dependent claim following independent claim 19, the missing reference "19" is inserted after "claim"; and in claim 29 the word "being" in the phrase "being a mean crystal grain size" is replaced by "having".

The Registrar: The Chairman:

R. Schumacher M. Rognoni

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D E C I S I O N
of 14 November 2001

Case Number: T 0779/96 - 3.4.1

Application Number: 83106573.5

Publication Number: 0101552

IPC: H01F 1/04

Language of the proceedings: EN

Title of invention:
Magnetic materials, permanent magnets and methods of making those

Patentee:
SUMITOMO SPECIAL METALS CO., LTD.

Opponent:
Ingenieurbüro Lebling
Pföhs, Erwin Dipl.-Ing.
GfE Gesellschaft für Elektrometallurgie mbH

Headword:
-

Relevant legal provisions:
EPC Art. 123(2), 123(3), 84, 54, 56

Keyword:
"Amended claims - added subject-matter (no)"
"Novelty (yes)"
"Inventive step (yes)"

Decisions cited:
-

Catchword:
-

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D E C I S I O N
of the Technical Board of Appeal 3.4.1
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Summary of Facts and Submissions

I. The appeals lie from the decision of the opposition division, dispatched on 9 July 1996 maintaining European patent No. 0 101 552 in amended form. The patent had been opposed by six parties, two of which (opponents 01 and 02) later withdrew their oppositions.

II. Appellant II (opponent 06) lodged the appeal and paid the prescribed fee on 10 September 1996. The statement of grounds of appeal was filed on 11 November 1996.

Appellant III (patentee) lodged the appeal and paid the prescribed fee on 16 September 1996. The statement of grounds of appeal was filed on 19 November 1996.

Appellant I (opponent 03), who had lodged an appeal and paid the appeal fee on 29 August 1996 and filed the statement of grounds of appeal on 6 November 1996, withdrew the opposition by a letter dated 20 April 1998, received on 23 April 1998.

III. The opposition by appellant II had been filed against the patent as a whole and based on Articles 100(a) and (c) EPC. The grounds of opposition pursuant to Article 100(a) EPC referred to objections under Articles 52(1), 54(1) and (2), and 56 EPC.

IV. With the statement of grounds of appeal, appellant II requested that the decision of the opposition division be set aside, the patent be revoked in its entirety and, as an auxiliary request, that oral proceedings be appointed.

By a letter dated 25 July 1997, appellant II withdrew the request for oral proceedings, informed the Board that they would not take part in oral proceedings and,

furthermore, requested a decision according to the state of the file which took the written submissions into consideration.

V. In an annex accompanying the summons to the oral proceedings dated 9 April 2001, the Board drew the parties' attention, *inter alia*, to the following documents:

D1: Chaban et al., Dopov. Akad. Nauk, UkSSR, Ser. A, No. 10, pages 873-878, 1979, and English translation thereof

D9: JP-A-54 76 419, and English translation thereof

D10: Hadjipanaysis et al., Journal of Magnetism and Magnetic Materials, vol. 21, 1980, pages 101-107

D31: US-A-4 402 770

D31A: US-patent application 6-314 325

D31B: US-patent application 6-314 326.

VI. At the oral proceedings which were held on 14 November 2001 and at the end of which the Board announced its decision only appellant III was represented.

VII. Appellant III requested that the decison under appeal be set aside and the patent be maintained in amended form on the basis of the following documents:

Claims: No. 1 to 29 filed in the oral proceedings;

Description: pages 2 to 26 filed in the oral proceedings;

Drawings: Figures 1 to 13 according to the patent specification.

VIII. The wording of claim 1 reads as follows:

"1. An alloy which can be magnetized to become a permanent magnet at room temperature and above, comprising 2 - 28 at% B, 8 - 30 at% R, where R stands for at least one rare earth element inclusive yttrium, and the balance being Fe, said alloy containing at least one stable compound of the ternary Fe-B-R type, having a tetragonal structure with its c_0 axis being about 1.2 nm (12Å) and its a_0 axis being about 0.8 nm (8Å), and the alloy having a mean crystal grain size of 1 to 80 µm."

The wording of claim 2 reads as follows:

"2. An alloy which can be magnetized to become a permanent magnet at room temperature and above, comprising 2 - 28 at% B, 8 - 30 at% R, where R stands for at least one rare earth element inclusive yttrium, further comprising at least one additional element M evident from the below list, the amounts of these elements being respectively limited to no more than the values specified hereinbelow by atomic percent

4.5% Ti,	8.0% Ni,	5.0% Bi,
9.5% V,	12.5% Nb,	10.5% Ta,
8.5% Cr,	9.5% Mo,	9.5% W,
8.0% Mn,	9.5% Al,	2.5% Sb,
7.0% Ge,	3.5% Sn,	5.5% Zr, and
5.5% Hf		

wherein, when two or more of M are applied, the total amount of M is limited to the highest value of one of the individual elements M, and the balance being Fe, said alloy containing at least one stable intermetallic compound of the Fe-B-R-M type, having a tetragonal structure with its c_0 axis being about 1.2 nm (12Å) and its a_0 axis being about 0.8 nm (8Å), and having a mean crystal grain size of 1 to 90 µm."

Independent claims 11 and 19 are directed to sintered anisotropic permanent magnets based on material compositions as specified in claims 1 and 2, respectively, and comprising at least 50 vol% of a phase consisting of at least one Fe-B-R type compound and of at least one Fe-B-R-M type compound, respectively, together with nonmagnetic phases.

Independent claims 25 and 26 are directed to processes of making a sintered anisotropic permanent magnet by providing a melt of a composition as specified in claims 1 and 2, respectively, whereby the claimed processes comprise the steps of cooling the melt to crystallize, powdering by grinding and pulverizing the cast alloy, orienting the resulting powder in a magnetic field and compacting it under pressure, and sintering the resulting compacted body at 1000 - 1200°C to achieve a sintered body having a mean crystal grain size of 1-80 µm or 1-90 µm, respectively, followed by cooling the body and magnetization.

Independent claim 29 is directed to a sintered magnetic material based on the alloy composition of claim 1 and further comprising nonmagnetic phases.

IX. In their statement of grounds of appeal, appellant II questioned whether a claim directed to an alloy material as such found support in the application as originally filed and contested that a claim directed to the alloy of the patent in suit was novel over any one of documents D1, D9, D10, and D31.

X. The arguments submitted by appellant III may be summarized as follows :

The originally-filed application documents referred repeatedly and consistently to the fact that alloys of the ternary Fe-B-R type or the intermetallic Fe-B-R-M type compound specified in the independent claims on file possessed magnetic properties which rendered the material suitable to become a permanent magnet at room temperature or above.

D1 did not provide unambiguous evidence that a ternary alloy of the Fe-B-R type having magnetic properties had existed before the oldest priority date claimed by the present patent. The phase diagrams shown in D1 did not provide any evidence of the existence of stable ternary compounds of the claimed tetragonal crystal type. From the fact that the authors of D1 did not succeed in identifying the composition and crystal structure of a speculative phase indicated as "1" in the phase diagrams, it had to be concluded that the experiments performed by the authors had not produced such a material and that thus such a material did not exist before the priority date of the contested patent. If, however, the ternary phase diagrams shown in D1 were considered as proof for the existence and availability of an alloy comprising a stable ternary Fe-B-R type compound having inherent magnetic properties, such an alloy could not be magnetized to become a permanent magnet at room temperature because the crystal grain size, resulting from the prolonged heat treatment

referred to in D1, could not be expected to lie within the range required for permanent magnetic properties, in particular for a coercive force above 1 kOe, to occur.

The teachings of documents D9, D10 and D31, related to a different type of ternary compounds which were formed by melt spinning, i.e. by a process which produced amorphous or microcrystalline structures since it involved a rapid cooling of the melt. The ternary compounds were "metastable" in that they could not be sintered without losing the magnetic properties.

Reasons for the Decision

1. The appeals comply with Articles 106 to 108 and Rule 64 EPC and are therefore admissible.

The non-appealing opponents 04 and 05 are parties as of right to the appeal procedure according to Article 107 EPC.

Appellant's I withdrawal of the opposition has to be interpreted as withdrawal of the appeal (see decision G 8/93, OJ EPO 1994, 887, point 2 of the reasons) so that appellant I has ceased to be a party to the proceedings.

2. *Amendments*

2.1 Claim 1 differs from claim 1 of the patent as granted essentially in that it defines the composition of the alloy, the crystal structure of the ternary Fe-B-R-phase and the range of the alloy mean crystal grain size. Although these features are specified for **sintered** samples of the alloy in the application

documents as originally filed (cf., for instance, page 18, lines 2 to 10, and page 31, last paragraph), the original disclosure makes it clear that the property of the alloy of the invention to become a permanent magnet at room temperature upon magnetization is inherent to the alloy as cast and not dependent on the alloy having undergone a treatment by sintering. In particular, it is specified in the description that "the inventive magnetic materials are advantageous in that they can be obtained in the form of at least as-cast alloy, or powder or granular alloys or a sintered mass" (page 8, second paragraph). Furthermore, the magnetic properties of such alloys (e.g. a coercive force of at least 1 kOe) are summarized in the chapter "Fe-B-R alloys" (cf. pages 10 and 11 and Table 1).

2.2 Similar considerations apply to claim 2 which comprises the features of claim 10 of the patent as granted and features relating to the composition of the alloy, the crystal structure of the compound Fe-B-R-M and the range of the alloy crystal mean size.

2.3 Claims 11 and 19 constitute limitations of claims 68 and 78 of the granted patent, in that they are based on the features recited in claims 1 and 2, respectively, and further specify that the respective permanent magnets comprise non-magnetic phases. The latter feature finds a basis of disclosure on page 15, last paragraph of the application as originally filed.

2.4 Process claims 25 and 26 are respectively based on claims 87 and 88 as granted with the addition of the range of sintering temperatures and the corresponding ranges of the resulting mean crystal grain sizes. These processes are disclosed on original page 22, page 31, last paragraph; page 41, third paragraph - page 42, second paragraph; and page 55, first paragraph.

2.5 Claim 29 is derived from claim 48 as granted and further comprises the specification of the tetragonal structure of the ternary Fe-B-R phase, the range of the mean crystal grain size and the presence of non-magnetic phases. The basis of disclosure for the amendments is the same as for claim 11.

2.6 The additional feature given in dependent claims 3, 12 and 20 is disclosed on page 14, second paragraph and page 55, first paragraph of the application as originally filed.

The additional feature given in dependent claims 4, 13 and 21 is disclosed on page 18, penultimate paragraph and page 40, third paragraph of the application as originally filed .

The additional features given in dependent claims 5, 6, 16, 17 and 24 are disclosed on page 16, last paragraph of the application as originally filed.

The additional feature given in dependent claims 7 and 18 are disclosed on page 27, second paragraph of the application as originally filed.

The additional feature given in dependent claim 8 is disclosed on page 22, third paragraph and page 41, last paragraph of the application as originally filed.

The additional features given in dependent claims 9, 10, 14, 15, 22 and 23 are disclosed on page 15, last paragraph of the application as originally filed.

2.7 For the above reasons, the Board is satisfied that the amendments to the claims comply with the requirements of Articles 123(2) and (3) EPC.

3. *State of the art*

3.1 Documents D31A and D31B have been filed to prove that document D31, published on 6 September 1983, was already available to the public on 18 May 1982, i.e. before the oldest priority date of the present patent. This evidence has not been contested by appellant III.

4. *Novelty and inventive step*

4.1 Document D1, entitled "Ternary {Nd, Sm, Gd}-Fe-B Systems", concerns a study of the phase equilibria in R-Fe-B ternary alloys. Using X-ray diffraction and microstructural analyses, the authors obtained phase equilibrium diagrams from samples produced by mixing and melting together the three constituents followed by casting and a prolonged (> 700 hours) heat treatment at 400°C to 800°C. In addition to previously known binary compounds, three novel ternary compounds of the approximative formula $R_3Fe_{16}B$, RFe_4B_4, and R_2FeB_3, respectively, were found for each of the three rare earth elements. The first one of these stable ternary compounds (labelled "1" in the phase diagrams) lies within the compositional ranges defined in the independent claims on file. Although the authors of D1 were unable to determine the exact crystal structure of this compound, similarities in X-ray diffraction patterns were observed for the three ternary compounds. From this observation it was concluded that the compound would be isostructural with the compound RFe_4B_4, for which it was possible to determine a tetragonal crystal structure and the corresponding lattice constants a_0 and c_0. Document D1 is silent on any specific properties of the ternary compounds and, in particular, on the fact that one of the compounds would be a magnetic material.

Nevertheless, the Board is convinced that the disclosure of the phase diagrams, which contain unambiguous indications as to the presence of stable ternary compounds, constitutes sufficient evidence for the fact that the ternary Fe-B-R alloys identified in D1 existed before the oldest priority date claimed by the present patent. Moreover, there can be no reasonable doubt that the authors of D1 had in fact produced the ternary compounds referred to in this document. In view of the similarities between the present invention and the teaching of D1 concerning the composition of the alloys and their manufacturing process, it has to be concluded that the alloy identified in D1 as the ternary compound "1" has the same tetragonal crystal structure, and consequently the same magnetic properties, as the stable ternary compound of the alloy according to claim 1. This finding is also supported by the fact that no other stable ternary phase exists in the compositional range around the compound "1" of D1.

It follows that the subject-matter of claim 1 differs from the alloy known from D1 only in that the former can be "magnetized to become a permanent magnet at room temperature and above" and has "a mean crystal grain size of 1 to 80 µm". As is apparent from the results given in Table 3 of the patent in suit, the claimed range for the mean crystal grain size is an indispensable feature for obtaining a coercive force of at least 1 kOe and is thus a prerequisite for the desired permanent magnetic properties. In the absence of any information relating to the mean crystal grain size of the ternary compounds according to D1, it would be mere speculation to assume that the mean crystal grain size of the alloy referred to in D1 would lie accidentally within the claimed range.

4.2 Thus, the subject-matter of claim 1 has to be regarded as new with respect to the disclosure of D1.

These considerations apply *mutatis mutandis* to the alloy specified in claim 2, which is further distinguished by the addition of at least one further element M, and to the permanent magnets and sintered magnetic material according to claims 11, 19 and 29, respectively.

As to the process claims 25 and 26, D1 does not suggest that the ternary compound "1" may have magnetic properties and, thus, it is not concerned with the steps to be performed for the production of sintered permanent magnets on the basis of such ternary compound.

4.3 Documents D9, D10 and D31 relate to magnetic alloys comprising a compound of the ternary Fe-B-R type and formed by melt-spinning. The alloys resulting from this manufacturing process are either amorphous or microcrystalline with a maximum grain size of 0.4 µm and, thus, do not fall within the claimed range. None of these documents contemplates sintering of the melt-spun alloys.

It follows that the subject-matter of the independent claims on file is also novel with respect to any one of documents D9, D10 and D31.

4.4 In the absence of any suggestion in the available prior art that an alloy containing a ternary Fe-B-R type compound or an intermetallic Fe-B-R-M type compound of a specific tetragonal crystal structure can be magnetized to become a permanent magnet at room

temperature when its mean crystal grain size falls within the claimed range, a person skilled in the art cannot be expected to arrive at the present invention without application of inventive skill.

4.5 For these reasons, the Board finds that the independent claims comply with the requirements of Articles 52(1), 54(1) and (2) and 56 EPC.

Moreover, the independent claims are clear and define all the necessary features so that they satisfy the requirements of Article 84 EPC in combination with Rule 29 EPC.

The dependent claims concern particular embodiments of the subject-matter of the corresponding independent claims.

5. In summary, the Board finds that the request of appellant III is allowable and that the contested patent can be maintained on the basis thereof.

Order

For these reasons it is decided that:

1. The decision under appeal is set aside.

2. The case is remitted to the department of first instance with the order to maintain the patent in amended form on the basis of claims 1 to 29, an amended description, both filed in oral proceedings and Figures 1 to 13 according to the patent specification.

The Registrar: The Chairman:

R. Schumacher M. Rognoni