BESCHWERDEKAMMERN DES EUROPÄISCHEN PATENTAMTS

BOARDS OF APPEAL OF THE EUROPEAN PATENT OFFICE

CHAMBRES DE RECOURS DE L'OFFICE EUROPEEN DES BREVETS

A		B		C	X

File No.: T 0914/92 - 3.5.2

Application No.: 87 104 135.6

Publication No.: 0 239 031

Classification: H01F 1/08

Title of invention: Magnetically anisotropic bond magnet, magnetic powder for the magnet, and method of manufacturing the powder.

D E C I S I O N
of 10 November 1993

Applicant: -

Proprietor of the patent: Hitachi Metals, Ltd.

Opponent: 1) Siemens AG
2) Vacuumschmelze GmbH, Hanau

Headword:

EPC: Art. 56 EPC

Keyword: "Inventive step - yes"

Headnote
Catchwords

Europäisches Patentamt | European Patent Office | Office européen des brevets

Beschwerdekammern | Boards of Appeal | Chambres de recours

Case Number: T 0914/92 - 3.5.2

D E C I S I O N
of the Technical Board of Appeal 3.5.2
of 10 November 1993

Appellant: (Opponent 01)
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Representative:
-

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Decision under appeal: **Interlocutory decision of the Opposition Division of the European Patent Office dated 7 August 1992 concerning maintenance of European patent No. 0 239 031 in amended form.**

Composition of the Board:

Chairman: R.E. Persson
Members: W.J.L. Wheeler
M.R.J. Villemin

Summary of facts and submissions

I. The Appellant contests the interlocutory decision of the Opposition Division that account being taken of the amendments made during the opposition proceedings, European Patent No. 0 239 031 and the invention to which it related met the requirements of the EPC.

II. Claim 1 reads as follows:

"1. A method of manufacturing magnetic powder for a magnetically anisotropic bond magnet, comprising the steps of rapidly-quenching a molten metal of the R-TM-B-M alloy, wherein R is at least one of rare earth elements including Y; TM is Fe or Fe a part of which has been substituted by Co; B is boron; and M is at least one selected from the group of Si, Al, Nb, Zr, Hf, Mo, P and C as additives, to make flakes of the alloy, compacting the flakes to form a high density body, plastically deforming the body to produce an alloy having an average crystal grain size of 0.01 to 0.5 µm and magnetic anisotropy, heat-treating the alloy to enhance the coercive force of the alloy and crushing it into particles of 1 to 1000 µm."

III. The following documents cited in the proceedings before the Opposition Division were referred to by the Appellant during the appeal proceedings:

D1: EP-A-0 155 082
D4: EP-A-0 133 758
D6: JP-A-59 219 904(abstract in Patent Abstracts of Japan, Vol. 9, Nr. 89 (E-309) [1812], 18 April 1985)
D13: IEEE Transactions on Magnetics, Vol. MAG-20, No. 5, September 1984, pages 1584 - 1589.

IV. In oral proceedings held on 10 November 1993, the Appellant filed a German translation of JP-A-59 219 904 (D6). The Respondent did not object.

V. The Appellant argued that the subject-matter of Claim 1 as maintained by the Opposition Division did not involve an inventive step. D4 disclosed a method of manufacturing a permanent magnet comprising all the steps specified in the claim except the final step of crushing the alloy. It was the normal practice when making a bond magnet to prepare a magnetic alloy, pulverise it and bind it with resin, as described in D1 and D6. Heat-treating the alloy to enhance its coercive force was also a normal practice, mentioned in D13. The translation of D6 described a method of making a bond magnet which included two crushing steps, so there was no prejudice against having more than one pulverising step. It was unimportant whether the compacting step was carried out on flakes, as in the present Claim 1, or on a crushed ingot, as in D6. It was obvious that in order to make a bond magnet from the alloy disclosed in D4, it was necessary to crush the alloy. The present Claim 1 did not recite any of the necessary subsequent steps for making an anisotropic bond magnet from the powder. Such subsequent steps would have a decisive influence on the properties of the final magnet, so that it was unimportant whether they were carried out on isotropic or anisotropic particles.

VI. The Respondent agreed that it was well known to make bond magnets by mixing magnetic powder with a resin binder, but pointed out that the present Claim 1 was directed to a method of making the magnetic powder. The skilled person would know what subsequent steps to take for making a bond magnet from the powder. D4 described a method for making an anisotropic bulk magnet which had very good properties. It was not obvious to subject the

magnet to any further processing such as crushing it into powder and binding the powder in a resin. The methods described in D1 and D6 started from ingot, not from flakes produced by rapid quenching. As could be seen from Table 2 of the present patent specification and the related text on page 5, the magnetic properties obtained starting from flakes were markedly better than those obtained starting from ingot. The second pulverising step in the method described in D6 was necessary to improve the magnetic properties of the sintered alloy. But this did not make it obvious to try to improve the already better magnetic properties of the magnet made by the method of D4 by crushing it and making a bond magnet from the powder. None of the cited documents suggested a method of making a magnetic powder for a magnetically anisotropic bond magnet comprising the combination of the steps of rapidly quenching a molten magnetic alloy to obtain flakes, compacting the flakes to form a high density body, plastically deforming the body to obtain anisotropy, and then crushing it.

VII. Opponent II (Vacuumschmelze) did not attend the oral proceedings.

VIII. The appellant (opponent I, Siemens) requested that the decision under appeal be set aside and that the patent be revoked.

IX. The respondent requested that the appeal be dismissed and that the patent be maintained as decided by the Opposition Division, subject to two further amendments of the patent specification:

1. The title to read: "Method of manufacturing magnetic powder for a magnetically anisotropic bond magnet"

2. Deletion of "If necessary," from page 4, line 1.

Reasons for the decision

1. The appeal is admissible.

2. The only question in dispute is whether the subject-matter of Claim 1 as maintained by the Opposition Division involves an inventive step within the meaning of Article 56 EPC.

2.1 There is common agreement between the appellant, the Respondent and the Board that D4 discloses a method of making a magnetically anisotropic permanent bulk magnet, comprising the steps of rapidly quenching a molten stream of R-TM-B alloy to obtain flakes of the alloy, compacting the flakes to form a high density body, and plastically deforming the body to produce an alloy having magnetic anisotropy. It is mentioned on page 7 that small amounts of carbon and silicon can be tolerated. D4 also mentions fine grain microstructures, where the grains have a maximum dimension of about 20 to 400 nm (i.e. 0.02 to 0.4 µm), which is within the range of 0.01 to 0.5 µm specified in Claim 1 of the patent in suit (D4, page 9). There is a hint that heat treating the alloy can enhance its coercive force if the starting material is overquenched (D4, pages 19 and 20).

2.2 There is also common agreement between the appellant, the respondent and the Board that the method of D4 ends with the production of a magnetically anisotropic permanent bulk magnet. D4 does not disclose crushing this magnet into particles of 1 to 1000 µm.

2.3 Interpreting the words "for a magnetically anisotropic bond magnet" in Claim 1 as meaning the powder must be suitable for use in making a magnetically anisotropic bond magnet, and noting that, as pointed out by the Appellant, the claim does not recite any steps for making a bond magnet from the powder, the method according to Claim 1 differs from the prior art known from D4 only in that it includes the further step of crushing a bulk magnet made by the method known from D4 into particles of 1 to 1000 µm.

2.4 Thus, the case turns on the following question: was it obvious to a person skilled in the art to crush a bulk magnet made by the method known from D4 into particles of 1 to 1000 µm?

2.5 The Appellant has argued that it was well known to make bond magnets from magnetic powder, as described in D1 and D6, and that it was obvious that in order to make a bond magnet from the material prepared by the method of D4, it was necessary to pulverise the material. This argument relies on the tacit assumption that it was obvious to make a bond magnet from the material made by the method of D4. The Board is not convinced that this tacit assumption is, as a matter of fact, valid.

2.6 In neither of the cited documents concerned with the manufacture of bond magnets, namely D1 and D6, is it suggested that the magnetic powder which is to be mixed with resin to form the bonded magnet could be obtained by crushing a permanent magnet produced by the method known from D4 (or by any other method).

2.7 D1 is mainly concerned with epoxy resins for use in making bond magnets. It discloses methods of making bond magnets, in which crushed melt-spun ribbon, or single domain-sized particles obtained by grinding ingot, are

mixed with epoxy resin powder. As is mentioned on page 1 of D1, the method of producing melt-spun ribbon entails rapidly quenching molten alloy. However, there is no suggestion in D1 that in the case of starting from crushed melt-spun ribbon (flakes), the flakes, after being compacted to form a high density body, may be plastically deformed, heat-treated and again crushed into fine particles before being mixed with the resin. The idea of pulverising a bulk magnet, however made and for whatever purpose, is not disclosed in D1.

2.8 D6 discloses a method of manufacturing a bond magnet comprising the steps of (1) making an R-TM-B-M alloy by high frequency melting, (2) grinding the alloy to a fine powder, (3) pressure forming the powder, which may be done in, or not in, a magnetic field, (4) sintering the formed material, (5) pulverising the sintered material, and (6) ... (not relevant). As pointed out by the Appellant, this method includes two pulverising steps. However, the first pulverising step (2) involves stamping and ball-milling, which is a technique quite different from producing flakes by rapidly quenching molten alloy, as recited in Claim 1, with the result that the material produced by steps (3) and (4) and pulverised in step (5) is different from the material crushed in the last step recited in the claim. There is no suggestion in D6 that the steps (1) and (2) could be replaced by rapidly quenching molten alloy to make flakes. On the contrary, it appears from page 3 of the translation that the D6 invention was made precisely in order to avoid the need for rapid quenching.

2.9 As pointed out by the Appellant, there is nothing in the cited prior art documents which would lead a skilled person to suppose that a bond magnet with improved magnetic properties could be obtained by pulverising a

bulk magnet made by the method described in D4. In the opinion of the Board, it was not obvious to do this.

2.10 In the result, the Board concludes that the subject-matter of Claim 1 as maintained by the Opposition Division involves an inventive step within the meaning of Article 56 EPC and the patent can be maintained with this claim. The same applies to Claims 2 to 4, which are properly dependent on Claim 1.

3. Regarding the two further amendments requested by the Respondent, the amendment of the title takes account of the fact that the present claims relate only to a method of manufacturing magnetic powder. The deletion of "if necessary" takes account of the fact that heat-treating the alloy to enhance the coercive force is a mandatory step in the method according to the present Claim 1. The Appellant did not object to these amendments (indeed, it was the Appellant who drew attention to the inconsistency between the description at the top of page 4 and Claim 1). In the opinion of the Board the amendments are allowable and the patent as amended and the invention to which it relates meet the requirements of the European Patent Convention.

Order

For these reasons, it is decided that:

The decision of the Opposition Division is confirmed, subject to the two further amendments requested by the Appellant in the oral proceedings (see paragraph IX above).

The Registrar

M. Kiehl

The Chairman

E. Persson