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D E C I S I O N
of 27 August 2002

Case Number: T 1046/00 - 3.2.3

Application Number: 97905537.3

Internation Publication Number: WO 97/30810

IPC: B22F 1/02, H01F 1/24

Language of the proceedings: EN

Title of invention:
A method of preparing a low oxygen iron-based powder

Applicant:
HÖGANÄS AB

Opponent:
-

Headword:
-

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

Keyword:
"Amendments - broadening of claim (yes)"
"Inventive step - (yes) after amendment"

Decisions cited:
-

Catchword:
-

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Case Number: T 1046/00 - 3.2.3

D E C I S I O N
of the Technical Board of Appeal 3.2.3
of 27 August 2002

Appellant: HÖGANÄS AB
S-26383 Höganäs (SE)

Representative: Thylén, Eva Matilda
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Decision under appeal: **Decision of the Examining Division 2.3.09.015 of the European Patent Office dated 6 July 2000 refusing European patent application No. 97 905 537.3 pursuant to Article 97(1) EPC.**

Composition of the Board:

Chairman: C. T. Wilson
Members: F. Brösamle
J. P. Seitz

Summary of Facts and Submissions

I. With decision of 6 July 2000 the examining division refused European patent application No. 97 905 537.3 in the light of

(D1) WO-A-95/29490 and

(D2) EP-A-0 434 669

for reasons of Articles 54 and 56 EPC.

II. Against the above decision of the examining division the applicant - appellant in the following - lodged an appeal on 1 September 2000 paying the fee on the same day and filing the statement of grounds of appeal on 5 October 2000 in which he argued that the accompanying claims defined novel and inventive subject-matter.

III. Following the board's Communication pursuant to Article 110(2) EPC in which the board raised objections under Articles 56 and 123(2) EPC the appellant filed new claims 1 to 4 according to his **main request**.

IV. Claims 1 and 4 thereof read as follows:

"1. A method of preparing a low oxygen iron-based, powder comprising particles of a base powder consisting of essentially pure iron having an insulating oxygen- and phosphorus-containing barrier, the oxygen content of the powder being at most 0.2 and at least 0.003 % by weight higher than the oxygen content of the base powder, the O:P ratio being between 15 and 2, most preferably between 10 and 3 as measured by the ESCA method, comprising the steps of preparing a base powder

consisting of a water-atomised iron powder or a sponge iron powder, subjecting the mixture to spraying with a solution of phosphoric acid in an organic solvent and drying the obtained mixture, wherein the solution of phosphoric acid is sprayed on the base powder while being mixed for a period sufficient to provide an insulating barrier of at most 100 nm as measured by the AES method on the particles."

"4. Use of a low oxygen powder comprising particles of a base powder consisting of essentially pure iron having an insulating oxygen- and phosphorus-containing barrier, wherein the oxygen content of the powder is at most 0.2 and at least 0.003 % by weight higher than the oxygen content of the base powder, the O:P ratio is between 15 and 2 and most preferably between 10 and 3 as measured by the ESCA method and the oxygen barrier has a thickness of at most 100 nm as measured by the AES method, for the preparation of soft magnetic components having a loss less than 600 W/kg at 1.5T/ 1000 Hz."

V. Appellant's arguments can be summarized as follows:

- (D1) discloses a process for the preparation of products - namely iron powders - having improved soft magnetic properties by applying phosphoric acid in water to achieve a circumferential layer of insulating material;

- starting from (D1) the purpose of the invention is to provide a method for improving the soft magnetic properties and the total loss for certain applications;

- claim 1 is based on an oxygen content of the powder being at most 0,2 and at least 0,003% by weight higher than the oxygen content of the base powder, on a O:P ratio being between 15 and 2 and on an insulating layer of at most 100 nm; this insulating layer according to claim 1 is achieved by subjecting the base powder to spraying with a solution of phosphoric acid in an organic solvent while mixing the base powder for a period sufficient to provide the above insulating layer;

- it is observed that the superior properties as demonstrated in the figures and tables of the refused application are particularly unexpected in view of the fact that more oxide improved the insulation according to general knowledge;

- (D1) being silent about spraying and only addressing mixing of the base powder, spraying was *per se* known from (D2) without, however, teaching a skilled person to have remarkable advantages with respect to other coating steps such as dipping or vapour deposition;

- under these circumstances a skilled person could not expect that spraying could achieve any superior effect with respect to dipping and vapour deposition so that even a combination of (D1) and (D2) would not lead a skilled person in an obvious way to the claimed invention.

VI. The appellant requested to set aside the decision under appeal and to grant the patent on the basis of claims 1 to 4 submitted with letter of 10 July 2002 (**main request**) or on the basis of above claims 1 to 3

(**auxiliary request**) in combination with a revised description filed simultaneously.

Reasons for the Decision

1. The appeal is admissible.

2. *Article 123(2) EPC*

2.1 Claim 1 is based on originally filed claims 1 (powder parameters), 3 (insulating layer) and 4 (method steps for achieving the wanted insulating barrier) and on Table 1, column "O_{added}".

2.2 Claims 2 and 3 are based on originally filed claims 5 and 6 and claim 4 is based on originally filed claims 1 (powder parameters) and 3 (insulating layer) as well as Figure 2 (low oxygen powder having a loss of less than 600 W/kg at 1,5 T/1000 Hz) and Table 1 (added oxygen).

2.3 Claim 4 is based on soft magnetic components having a loss less than 600 W/kg at 1,5 T/1000 Hz. The parameter "loss" or "total loss" in the originally filed documents is only disclosed in its Figure 2 representing *inter alia* a non insulated base powder (having a total loss of about 800 W/kg being well above the claimed value), furthermore samples "A" according to the invention (having a total loss below approximately 500 W/kg) and according to (D1), Ref. B, and DE-C-3 439 397, Ref. C. None of the above values are actually quoted in the application, but can only be read off approximately from the graph. Considering above Figure 2 and the further documents originally filed there cannot be derived the threshold claimed of

less than 600 W/kg at 1,5 T/1000 Hz so that claim 4 does not meet the requirements of Article 123(2) EPC. Under these circumstances the **main request** is not allowable.

2.4 Claim 4 not being part of the **auxiliary request** this request is not open to an objection under Article 123(2) EPC.

Auxiliary request

3. *Novelty*

The subject-matter of claim 1 is novel with respect to (D1) which is silent about spraying as the treatment step for applying a phosphoric acid, see page 4, lines 10 and 24, and since (D2) does not disclose an addition of oxygen in the claimed range or a ratio of oxygen and phosphorus in the range between 15 and 2 according to claim 1, but rather is based on the application of a metal alkoxide instead of phosphoric acid.

4. *Inventive step*

4.1 From (D1) a process for preparing products having improved soft magnetic properties is known in which process essentially the content of phosphorus is observed, see claims 2 and 14, however, not its ratio with respect to oxygen. The total loss of a powder according to (D1) is 700 W/kg when applying 1,5 T/1000 Hz as can be seen from the comparison with another magnetic iron powder, see table on the bottom of page 9 of (D1).

4.2 Starting from (D1) as the nearest prior art to be considered the objectively remaining technical problem to be solved by the invention is to provide a method for improving the soft magnetic properties and if needed for certain applications the total loss.

4.3 This problem is solved by the features of claim 1, namel y by adding a small, limited amount of oxygen to the base powder between 0,2 and at least 0,003% by weight and by observing an O:P ratio between 15 and 2 to achieve an extremely thin insulating layer of at most 100 nm on the particles when subjecting the base powder to spraying with a solution of phosphoric acid in an organic solvent while mixing the base powder for a sufficient period and thereafter drying the obtained powder mixture.

4.4 The advantages of the method according to claim 1 can be seen from Figures 1 and 2 of the application demonstrating that the powder obtained by the method of claim 1 is clearly superior to reference powders "B" and "C" of the prior art with respect to total loss. These results are **unexpected** since normally a skilled person would have relied on an insulating layer **by far thicker** than claimed (100 nm) since it was general technical knowledge that more oxide improved the insulation. Bearing this fact in mind a skilled person starting from the prior art disclosed in (D1) could not rely on general technical knowledge, but rather had to follow new ways.

4.5 This consideration is also relevant with respect to the procedural steps of how phosphoric acid is applied to the base powder since (D1) is silent about the possibility of **spraying** and only discloses mixing of

the base powder when being treated with phosphoric acid, see page 4, lines 10/24 and page 9, lines 17 to 20 of (D1).

4.6 The further piece of prior art to be considered is (D2) which document *per se* teaches spraying, see pages 3, line 40, without, however, disclosing **any priority for spraying** with respect to further treatment steps dealt with, such as dipping or vapour depositing, see page 3, lines 38 to 42 of (D2).

4.7 Under these circumstances a skilled person considering (D1) and (D2) even in combination could not expect that spraying in combination with the parameters laid down in cla im 1 could achieve the advantageous effects inherent in the powder achieved by the method according to claim 1 and being convincingly proved by the appellant by comparative tests with respect to known iron based low oxygen powders.

4.8 Summarizing, the method of claim 1 is novel and not rendered obvious by the prior art according to (D1) and (D2) and by the application of general technical knowledge so that claim 1 is allowable.

This is also true for claims 2 and 3 relating to embodiments of the subject-matter of claim 1.

4.9 In the revised description filed with letter of 10 July 2002 the prior art is discussed and the problem to be solved by the invention and its solution are set out so that the requirements of Rule 27 EPC are met.

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 grant a patent on the basis of the auxiliary request:

Claims: 1 to 3 submitted with letter of 10 July 2002, received on 13 July 2002.

Description: pages 1, 2, 4 to 7 of WO-A-97/30810; pages 3, 3a submitted with letter of 10 July 2002, received on 13 July 2002.

Drawings: Sheet 1/1 with Figures 1 and 2.

The Registrar: The Chairman:

A. Counillon C. T. Wilson