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Datasheet for the decision of 14 March 2011

Case Number: T 0883/08 - 3.3.05

Application Number: 98943071.5

Publication Number: 0940824

IPC: H01F 1/11

Language of the proceedings: EN

Title of invention:
Magnet powder, sintered magnet, method of manufacturing these materials, bonded magnet, motor, and magnetic recording medium

Patentee:
TDK Corporation

Opponent:
Shanghai Dongbao Magnetic Material Co., Ltd.

Headword:
Sintered magnet/TDK Corp.

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

Relevant legal provisions (EPC 1973):
-

Keyword:
"Added subject-matter (main request): no"
"Novelty (main request): yes"
"Inventive step (main request): yes"

Decisions cited:
-

Catchword:
-

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Case Number: T 0883/08 **-** 3.3.05

D E C I S I O N
of the Technical Board of Appeal 3.3.05
of 14 March 2011

Appellant: (Patent Proprietor)
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Decision under appeal: **Decision of the Opposition Division of the European Patent Office posted 29 February 2008 revoking European patent No. 0940824 pursuant to Article 102(1) EPC.**

Composition of the Board:

Chairman: G. Raths
Members: H. Engl
D. Prietzel-Funk

Summary of Facts and Submissions

I. This appeal is from the decision of the opposition division posted on 29 February 2008 revoking European patent EP-B-0 940 824.

II. The cited documents include the following:

D1: Smolenski et al., Bulletin of the Academy of Sciences of the USSR, 1961, Vol. 25, No. 11, pages 1392 to 1394
&
English translation thereof, pages 1405 to 1408

D2: JP-B2-05 421 128, English translation thereof

D3: US-A-5 061 412

D5: EP-A-0 758 786

D7: JP-A-31 1287 and English translation thereof.

III. The patent was revoked in opposition proceedings on the ground that claim 1 of the main request lacked novelty having regard to document D6. For the subject-matter claimed in accordance with the auxiliary requests, no inventive step could be acknowledged. The opposition division held that in the absence of a particular technical effect demonstrated for the whole breadth of the claims, merely finding an alternative process for producing the magnetoplumbites of D1 was obvious in view of documents D2, D4, D5 or D6.

IV. With the letter stating the grounds for appeal the appellant filed new claims in accordance with a main and three auxiliary requests, and in a later submission dated 3 June 2009 filed a new main request and amended first to fifth auxiliary requests.

The submission of 11 February 2011 contained new experimental results and an affidavit by Mr Taguchi.

V. With its reply, the respondent filed *inter alia* the new document

D21: Textbook "Ferrites", edited by Du Youwei, first edition, published April 1996, Jiangsu Science and Technology Publishing House, ISBN 7-5345-2044-4, in Chinese language, pages 1 to 7, 14, 62, 63, 67, 84, 85, 159, 263, 237, 264, 269 and 271;
&
D21a: Partial translation thereof into English

A further submission of the respondent was received with letter dated 14 February 2011.

VI. Oral proceedings took place on 14 March 2011. The appellant submitted a new main and a first auxiliary request, replacing all previously filed requests.

VII. The independent product and process claims of the said main request, comprising 12 claims, have the following wording:

"1. A process for producing a hexagonal magnetoplumbite ferrite sintered magnet comprising a primary phase of a hexagonal ferrite containing A', R, Fe, and Co, wherein

A' represents Sr in a proportion of 51 atomic % or more, and optionally one or more of Ba, Ca and Pb, and

R represents La in a proportion of 40 atomic % or more and optionally at least one element selected from the rare earth elements (including Y);

the proportions of said elements with respect to the total amount of said metallic elements are

from 1 to 13 atomic % for A',
from 0.05 to 10 atomic % for R,
from 80 to 95 atomic % for Fe, and
from 0.1 to 5 atomic % for Co;

the process comprises

- adding Co and La to calcined particles comprising a primary phase of a hexagonal ferrite containing at least Sr, Ba or Ca,
— then molding the resulting mixture, and
— sintering it."

"11. A magnet when produced by a process as claimed in any one of the preceding claims."

"12. A motor comprising a magnet as claimed in claim 11."

VIII. The appellant essentially argued as follows:

*Late-filed document*s

Documents D21 and D21a should be disregarded by the board as late filed and not ***prima facie*** relevant.

Novelty

The claimed subject-matter was novel over D1 which did not disclose a hexagonal ferrite sintered magnet in which the proportion of Sr in A' was 51 atomic-% or more.

Inventive step

Starting from D1 as the closest prior art, the process of the invention differed by the step of

- *"adding a part or all of the constituent elements … to calcined particles comprising the primary phase of the hexagonal ferrite"*

and by the limitation

- *"provided that the proportion of Sr in A' is 51 atomic-% or more".*

The technical effect associated with the first differing feature was explained in paragraph [0055] of the patent. Further technical effects achieved by the claimed process, and accordingly by the magnet of claim 13, were the simultaneous improvement of several parameters as set out in paragraph [0013] *et seq.* of the patent, including high coercivity, high remanence, two Curie temperatures, a low temperature dependence of HcJ, and an improved squareness of the demagnetization curve, or the achievement of the same performance as the prior art, but with a reduced cobalt content.

With respect to the second differing feature, the appellant observed that D1 did not relate to magnetic materials containing Sr. The only documents of relevance relating to such magnetic materials

containing Sr were D2 and D3. However, these materials did not contain a rare earth element.

There was no incentive for the skilled person starting from D1 and aiming to solve the problem of improving the magnetic properties of hexagonal sintered ferrite magnetic materials comprising Sr, Co and a rare earth element to replace Ba in D1 by Sr, but maintaining the rare earth content, and at the same time to change the manufacturing method by adding Co separately.

The experimental evidence submitted with letter of 11 February 2011 proved that the samples of the invention (x = 0.1, 0.2 and 0.3) in the magnet of the formula $Sr_{1-x}La_xFe_{12-x}Co_xO_{19}$ exhibited better magnetic properties (higher residual magnetic flux density Br and intrinsic coercive force HcJ) both at +25°C and -40°C (see Tables 4 and 5) as well as a better temperature characteristic (Table 6). These improvements provided strong support for the presence of an inventive step.

IX. The respondent essentially argued as follows:

Late filed documents

D21 should be admitted because it had been filed in response to newly submitted claims during the appeal stage.

The experimental evidence submitted by the appellant with letter of 11 February 2011 was filed late and should not be admitted. Moreover, the data were

affected by uncertainties and did not allow a direct comparison with the closest prior art.

Article 123(2) EPC

Claim 1 of the main request related to a process for producing a primary phase of a hexagonal ferrite containing A', R, Fe and Co, wherein the definitions for these components were allegedly taken from paragraphs [0058] to [0060] of the patent. However, these passages referred to a ***"hexagonal magnetoplumbite ferrite containing Sr, Ba or Ca, Co and R"***. There was no unambiguous disclosure of the primary phase containing A', R, Fe and Co.

Claim 1 contravened Article 123(2) EPC because the claim feature ***"adding Co and La to the calcined particles"*** had no appropriate basis in paragraphs [0029] or [0030] of the original application documents published as EP-A-0 940 824. Said paragraph [0029] explicitly required that not only Co and La but also Sr, Fe and other elements be added.

Amended claim 10 required that the ferrite particles had a two-phase structure such that the magnet had at least two different Curie temperatures. However, such a connection between the two claim features was not originally disclosed.

Lack of clarity

Several clarity objections were raised, in particular against claims 1 and 12 of the main request, and the corresponding claims of the auxiliary request.

Furthermore, the respondent objected that claims 6 to 10 of the main request defined the invention in terms of a result to be achieved, which should not be allowed according to the Guidelines, C-III 4.10.

Inventive step

The respondent emphasised that adding the additives after calcining was known in the art (from D4 for La; from D2 or D3 for Co; from D21 for additives in general).

The respondent argued that the advantageous properties on which the patentee relied were not obtainable over the whole breadth of the claims.

i Lack of inventive step over D1 and D2

D1 disclosed all the structural elements of the hexagonal ferrite sintered magnet of claim 13. Claim 1 (main request) differed only by the process step of ***"adding Co and La to calcined particles comprising a primary phase of a hexagonal ferrite containing at least Sr, Ba or Ca"*** (***i.e.*** the "post-addition" claim feature).

As no specific effect was associated with this measure, the objective technical problem underlying the alleged invention was to provide for an alternative method of producing a hexagonal ferrite sintered magnet.

The claimed solution was obvious in view of D2 which disclosed the post-addition of Cobalt oxide after the calcining of a Sr, Ba, Pb ferrite.

Similar arguments applied to a combination of D1 and D3 (post-addition of cobalt), and D1 and D4 (post-addition of lanthanum oxide).

ii Lack of inventive step over D5 and D2

D5, which was regarded as the closest prior art, disclosed a process for producing a hexagonal ferrite sintered magnet having a primary phase of a hexagonal magnetoplumbite ferrite of the formula $A_{1-x}R_x(Fe_{12-y}M_y)_zO_{19}$ wherein A represented Sr, Ba, Ca or Pb; R represented at least one of the rare earth elements including Y and Bi; and M was Zn or Cd. The process of manufacture included optionally the step of adding various additives to the calcined ferrite powder. The time of addition was not critical.

The only difference between the subject-matter of claim 1 according to the main request and D5 was that D5 disclosed M to be Zn or Cd, rather than Co.

The effect of the said difference was, according to the appellant, a slight improvement in coercive force and residual magnetic flux. The technical problem underlying the patent in suit was thus to provide for a hexagonal ferrite sintered magnet having an improved coercive force whilst maintaining a high residual magnetic flux.

The skilled person confronted with this technical problem would turn to document D2 which explicitly stated that Cobalt oxide could be used as an additive for raising the intrinsic coercive force HcJ. It was also stated that this additive (together with others)

should be added after the fundamental composition was calcined and crushed into a fine powder. It was also known (and confirmed for example by D21) that the contribution of Co^{2+} to the magnetic anisotropy was high, Co^{2+} being more magnetic than Zn. Therefore, the obvious combination of D5 and D2 would inevitably lead the skilled person to the claimed invention.

iii Lack of inventive step over D5 and D7

Starting from the M-type magnet $La_xSr_{1-x}Fe_{12-x}Zn_xO_{19}$ disclosed in D5, it was clear that the intrinsic coercive force HcJ decreased with the replacement ratio (the degree of substitution). It was also known that Zn^{2+} was a non-magnetic ion, whereas Co^{2+} was a magnetic ion like Fe^{3+}. Therefore, substituting Co^{2+} for Zn^{2+} in the above-mentioned magnet should increase HcJ, especially when x was small.

From D7 it was known to improve the residual magnetic flux density by mixing a powder A (consisting of $BaCO_3$ and Fe_2O_3 in a molar ratio of 1:5.5) with a powder B (calcined $BaO_{5.5}Fe_2O_3$) before a final sintering step. Applying this teaching to D5 and mixing A' with B' (calcined $La_{0.2}Sr_{0.8}Fe_{11.8}Co_{0.2}O_{19}$) resulted in a magnet possessing two Curie temperatures and having a composition falling under claim 1.

X. Requests:

The appellant requested that the decision under appeal be set aside and that the patent be maintained on the basis of the main request or the first auxiliary request,

both requests having been filed during the oral proceedings.

The respondent requested that the appeal be dismissed.

Reasons for the Decision

1. Amendments *(main request)*

1.1 Claim 1 is based on the disclosure of process claim 21 as originally filed and the description, page 10, lines 57 and 58, and on paragraphs [0057], [0060] and [0061] of the application documents as originally filed (published as EP-A-0 940 824).

The term *"magnetoplumbite ferrite"* is disclosed for instance in original claim 3.

The claim feature relating to the post-addition of Co and La to calcined particles comprising a primary phase of a hexagonal ferrite is based on the original disclosure of paragraph [0030] of the description. In this paragraph it is stated not only that La, Co and Fe are added to the Sr (or Ba or Ca) ferrite but also that the ensuing reaction will give rise to M-type ferrite parts rich in Co and La and to M-type ferrite parts poor in them. Furthermore, diffusion of Co and La is disclosed as being higher in the surface part of the sintered grains than in the centre part thereof. The Curie temperature of the grains is disclosed to depend on the degree of substitution of La and Co.

From this information the skilled person can derive that post-addition of Co and La was essential for producing the desired two-phase structure composed of magnetically different M-type ferrites having two different Curie temperatures.

1.2 Claim 11 is based on the original disclosure of claims 10 to 13.

Claim 12 is based on the original disclosure of claim 19.

1.3 Dependent claims 2 to 9 are based on claims 23, 24, 25, 26, 6, 15, 1 and 17, respectively.

Dependent claim 10 is based on original claim 10 and the description, paragraphs [0048], [0053] and [0055]. Said passages disclose a magnetic material having at least two different Curie temperatures Tc1 and Tc2 within a range from 400 to 480°C, and preferably from 430 to 460°C. In the board's view, it is unambiguously derivable from the said description passages, in particular from paragraph [0055], that the ferrite particles' two-phase structure is associated with and gives rise to the presence of two Curie temperatures.

1.4 No objection under Article 123(3) EPC arises, as the amendments clearly limit the scope of protection conferred by the claims, having regard to the claims as granted.

2. Clarity

2.1 The respondent raised several objections against clarity of the claims with respect to Article 84 EPC.

It maintained that the terms *"particles of ferrite"* and *"at least two Curie temperatures"* in claim 10 were unclear and that claims 6 to 10 (8 to 10 of the main request filed with letter of 3 June 2009) defined the invention in terms of the result to be achieved and also left the skilled person in doubt as to how the claimed result was to be achieved. However, these objections - both concerning features which were already present in the granted claims - are inadmissible under Article 100 EPC because they do not belong to the grounds of objections which are exhaustively enumerated in this Article.

2.2 The same applies to the question raised by the respondent whether or not the disclosure of Figure 10 supported the subject-matter of dependent claim 10, in particular the temperature range within which the two Curie temperatures fell and the absolute difference between them, as recited in claim 10. The question of support of the claims under Article 84 EPC is not admissible under Article 100 EPC, where the subject-matter in question was already present in a granted claim, which is the case here in granted claim 14.

3. Late-filed documents

3.1 The appellant requested that documents D21 and D21a be disregarded by the board as late filed and not ***prima facie*** relevant.

The board did not see a need to formally decide this question because - as will become apparent in the following discussion - the final decision to be taken does not depend on the admission of D21 and D21a.

3.2 Additional experimental data and an affidavit by the experimenter, Dr Taguchi, were submitted by the appellant with letter dated 11 February 2011, a little more than one month before the date scheduled for the oral proceedings. The respondent requested that this experimental evidence be disregarded as late filed.

The board decided not to admit these pieces of evidence, for the reasons that, firstly, the point of time of their submission effectively prevented the respondent from preparing any counter-experiments; and secondly, the experiments and their results raise a number of questions which were not likely to be resolved before or during the oral proceedings. Reference is in this respect made to the respondent's letter dated 7 March 2011, points 3 to 6, regarding uncertainties with respect to impurities, the composition analysis by fluorescent X-ray analysis, and the amounts of Fe_2O_3.

4. Novelty

4.1 No novelty objections were raised by the respondent against the claims of the main request.

4.2 The board, having duly examined the available prior art, also acknowledges the novelty of the claimed products and processes, for the following reasons:

4.2.1 Document D1 discloses sintered barium ferrites wherein part of the Ba^{2+} is substituted with rare earth elements M^{3+} and simultaneously, for reasons of electroneutrality, part of the Fe^{3+} is substituted by a divalent ion (Ni^{2+}, Mg^{2+} or Co^{2+}) (page 1405, fourth paragraph; page 1406, Figures 1 and 2). A decrease in saturation magnetisation, comparable to the residual magnetic flux density Br, was observed due to the introduction of the rare earth elements.

According to Figure 1 (graph #1) of D1, specimens were investigated having the nominal composition (solid solution)

$(1-x)BaFe_{12}O_{19} - xM^{3+}Fe_{11}{}^{3+}M^{2+}O_{19}$

wherein
$M^{3+} = La^{3+}$
$M^{2+} = Co^{2+}$
and x = 0, 0.1, 0.2, 0.3, 0.4, 0.5, 0.6, 0.7 and 0.8.

For x = 0.2, the above formula translates into

$Ba_{0.8}La_{0.2}Fe_{11.8}Co_{0.2}O_{19}$

and the proportion of the metals are

Ba: 6.16 at-%
La 1.54 at-%
Fe 90.8 at-%
Co 1.54 at-%

This compound and magnets made therefrom differ from the subject-matter claimed in claim 11 of the main

request at least in that they contain Ba instead of Sr. Consequently, also the motor according to claim 12 comprising a magnet as claimed in claim 11 is novel over D1.

The method of manufacture according to claim 1 of the opposed patent (main request) differs from the method disclosed in D1 in that it involves the post-addition step of adding Co and La to calcined particles comprising a primary phase of a hexagonal ferrite, before molding and sintering the mixture.

Therefore, the claimed subject-matter is novel over D1.

4.2.2 Document D5 discloses hexagonal magnetoplumbite ferrites of the formula

$A_{1-x}R_x(Fe_{12-y}M_y)_zO_{19}$

wherein

A represents Sr, Ba, Ca, or Pb

R represents at least one rare earth element including Y or Bi

R essentially contains La (preferably 40%, more preferably 70%)

M Zn or Cd

(see page 4, lines 45 to 58).

Therefore, the magnetoplumbite ferrites of D5 differ from the ones of the patent in suit at least by the presence of Co ***in lieu*** of Zn or Cd.

4.2.3 D7 discloses a particular process for the manufacture of sintered Ba, Sr, Pb ferrite magnets which do not contain Co or rare earth elements as required by claim 1 of the patent in suit.

4.2.4 D2 discloses a process for the manufacture of sintered ferrite magnets having a high Br and iHc based on Fe_2O_3 and MO (M is Pb, Ba, Sr). CoO and specific quantities of CaO, SiO_2, Cr_2O_3 and/or Al_2O_3 are added after calcining of the fundamental composition (post-addition). However, the disclosed magnets do not contain rare earth elements and there is no concrete working example of a Sr-ferrite based magnet.

4.3 The claims in accordance with the main request thus meet the requirements of Article 54 EPC.

5. Inventive step

5.1 *The invention*

The invention is concerned with a process for making a sintered hexagonal magnetoplumbite ferrite magnet and with a sintered magnet produced by the said process.

More specifically, the patent in suit aims at sintered magnets having a high residual magnetic flux density (Br), a high intrinsic coercive force (HcJ), and an excellent temperature characteristic of Br and HcJ, and an excellent squareness of the demagnetisation curve (see paragraph [0013] of the patent specification).

Preferably, the opposed patent aims at producing sintered magnets having Br and HcJ properties so as to obey either

equation I : Br + 1/3 HcJ ≥ 5.75 (for HcJ ≥ 4) or
equation II : Br + 1/10 HcJ ≥ 4.82 for HcJ < 4)

(see paragraph [0031]).

5.2 *Closest prior art*

During the oral proceedings, the respondent considered document D5 to represent the closest prior art. The board agrees.

As already discussed above (point 4.2.2), D5 discloses hexagonal magnetoplumbite ferrites and sintered magnets made therefrom, the ferrites having the formula

$A_{1-x}La_x(Fe_{12-y}M_y)_zO_{19}$

wherein
A represents Sr, Ba, Ca, or Pb
R represents at least one rare earth element including Y or Bi
M Zn or Cd.

Preferred are sintered magnets of formula

$Sr_{1-x}La_xFe_{12-x}Zn_xO_{19}$

for x = 0, 0.05, 0.1, 0.2, 0.3, 0.4, 0.45 and 0.5 (see examples 1 and 2).

According to the description (page 6, lines 6 to 9 and page 7, lines 25 to 28), additives, for example compounds containing Si, Ca, Pb, Al, Ga, Sn, In, Co, Ni, Ti, Mn, Cu, Ge, Nb, Zr, Li etc., may be added. Example 4 discloses the calcined bodies of example 1 which additionally contain the additives Si + Ca; or Si + Sr; or Si and Ba.

According to page 7, line 58 to page 8, line 9, the time of addition of the said additives is not critical. Preferably, they may be added during pulverisation of the calcined body. However, there is no disclosure of post-addition of Co and La, or even of La alone.

5.3 *Problem*

Starting from D5, the problem of the opposed patent may be defined as providing a sintered magnetoplumbite ferrite magnet having a high residual magnetic flux density (Br), a high intrinsic coercive force (HcJ), and an excellent temperature characteristic of Br and HcJ, and a small specific resistivity, achievable at low levels of Co, as well as a method of producing the same (see paragraph [0013]).

5.4 *Solution*

As a solution to the problem defined above, the opposed patent proposes a process for preparing a hexagonal magnetoplumbite ferrite sintered magnet according to claim 1, characterised in that

- the ferrite contains Co (instead of Zn or Cd); and
- Co and La are added to calcined particles

comprising a primary phase of a hexagonal ferrite containing at least Sr, Ba or Ca, Co and a rare earth element.

5.5 *Success*

It now has to be examined whether the technical problem has been successfully solved.

5.5.1 Examples 1 and 2 and Tables 4 and 5 of the opposed patent present comparative data of samples prepared according to the process of the invention (post-addition) (samples #1 and #2) and samples prepared with the additive compounds added before calcination (sample #3). It is evident from these data that the samples of the invention exhibited a higher Br (in kG) (#1: 4.34 and #2: 4.75 ***vs.*** #3: 4.33) and higher $(BH)_{max}$ (4.6 and 4.7 ***vs.*** 4.5) at comparative or even better levels of HcJ (in kOe) (4.60 and 4.75 ***vs.*** 4.61). Table 5 reveals that samples #1 and #2 exhibited significantly smaller specific resistivities than comparative sample #3.

5.5.2 Furthermore, example 1 and comparative example 1, in particular sample 3 and Figure 15, show that magnets obtained by the process of the invention where La and Co were added after calcination had a higher density and a higher degree of magnetic orientation (Ir/Is). Although HcJ was lower, the residual magnetic flux density Br was high.

5.5.3 Example 2 and Figure 11 of the opposed patent demonstrate that samples produced with the additive added after calcination exhibited a higher level of HcJ

at lower levels of addition of Co (x= 0.2) than the comparative samples. Therefore, the process of the invention results in a potentially substantial saving of the expensive element Co (as set out in paragraph [0138] of the patent).

5.5.4 The respondent argued that the technical effect of improving HcJ and Br was not achieved over the entire breadth of the claims. The respondent pointed in particular to compositions allegedly not presenting an improved squareness Hk/HcJ and/or not satisfying equations I or II of the opposed patent (paragraph [0031]) with respect to Br and HcJ (see point 5.1 above).

The board considers that the compositions satisfying the conditions of equations I or II are designated as preferred compositions in the sense that only particular M-type ferrites of the invention containing optimum amounts of Co and La can satisfy them (as is demonstrated by, for instance, samples 1 and 2 [Table 4]). So, if not all the embodiments encompassed by the claimed subject-matter satisfy the additional specific requirements of the equations, this does not mean that they would not solve the problem posed under point 5.1. Incidentally, the board observes that the statement in paragraph [0031] of the opposed patent that no conventional Sr ferrite sintered magnet exhibited HcJ > 4 kOe and satisfied equation I has not been contested.

5.5.5 In view of the above, the board is satisfied that the problem underlying the opposed patent has been successfully solved.

5.6 *Obviousness*

It remains to be decided whether the claimed solution was obvious in view of the prior art.

During oral proceedings the respondent presented essentially three different lines of argument, each one starting from D5 as the closest prior art.

5.6.1 *Obviousness in view of the skilled person's general knowledge, as exemplified by D21*

a) The respondent argued that, according to D21, Co^{2+} was frequently used to replace Fe^{2+} (pages 14 and 62); and Ba^{2+}, Sr^{2+}, alkaline earth metal ions and La could replace an A-ion in a magnetoplumbite ferrite of $AB_{12}O_{19}$ type (D21, pages 84 and 85). The contribution of Co^{2+} to the (magnetic) anisotropy was relatively strong and the macroscopic magnetic crystal anisotropy was known to be the sum of the contributions of the individual ions. This would have prompted the skilled person to replace Fe^{2+} with Co^{2+}.

D21 also taught that a SrM (M = $Fe_{12}O_{19}$) ferrite was particularly suitable as a magnet and had better properties than the corresponding Ba ferrite (BaM) (D21, page 264).

Furthermore, D21 also taught the post-addition of additives to enhance magnetic properties (pages 159, 237 and 271).

b) However, in the board's view, these arguments are not convincing, for the following reasons:

D5 proposes hexagonal magnetoplumbite ferrites of the formula

$A_{1-x}La_x(Fe_{12-y}M_y)_zO_{19}$ $(0.04 \leq y \leq 0.45)$

wherein a part of the Fe (the Fe^{3+} ions at particular lattice positions $4f_1$ as shown in Figure 17 of D5) is replaced by the bivalent ions M = Zn^{2+} or Cd^{2+}. The purpose of the said replacement of Fe^{3+} by M is to increase the saturation magnetisation (D5, page 3, lines 6 to 14; claim 1). In order to compensate for the differences in valence, further substitution of A (= Sr^{2+}, Ba^{2+}, Ca^{2+}, or Pb^{2+}) by R (preferably La^{3+}) becomes necessary, thereby arriving at the magnets according to D5 which are reported to have high saturation magnetisation and high $(BH)_{max}$ (page 3, lines 21 to 28).

Therefore, the respondent's proposal of replacing Fe by Co would go against the explicit teaching of D5 according to which the presence of Zn or Cd is mandatory.

Furthermore, the board considers that D21 does not specifically propose substituting Co for Fe in a particular ferrite, such as the one disclosed in D5. The substitution would not fulfil a particular foreseeable purpose in the said ferrite of D5 and would not be considered by the skilled person as a viable way of solving the problem posed.

As regards the post-addition of La and Co, it is not suggested by D21. D21 only discloses the addition of certain additives before or after the first mixing or ball milling step, to refine the grains and to prevent the grains from overgrowing, so as to get a high Hc and a high Br. Co is not among the list of substances disclosed in D21 as useful for that purpose, and La is mentioned only generically ("rare earth oxides") (pages 237, 271). Therefore, D21 cannot suggest the post-addition of these two elements according to the opposed patent.

The respondent's first approach must therefore fail.

5.6.2 *Obviousness in view of D2 and D4*

D2 (see D2a, page 2, last paragraph; page 3, last paragraph) is concerned with a process of producing a high performance sintered ferrite MO/Fe_2O_3 magnet (M = Pb, Ba, Sr) having a high Br and iHc. Such a ferrite magnet is obtained by calcining and crushing the fundamental ferrite composition, adding a specific quantity of CoO together with a specific quantity of CaO, SiO_2 and Cr_2O_3 and/or Al_2O_3 to the resultant material, molding and sintering it in a magnetic field.

D2 thus proposes a process similar to the one of the opposed patent in that Co is added to the calcined ferrites in a post-addition step. It would have been obvious to adopt the same process step for producing the magnets of D5. The respondent argued that the effect of adding La was not clear from the opposed patent and should therefore be disregarded with respect

to the claimed solution. In any event, post-addition of La was known from D4.

In the board's view, this argument is not convincing, as it would require the skilled person to remove the essential constituents Zn or Cd from the composition of D5 and to replace them by Co. Furthermore, the effects of the post-addition of La (and Co) is demonstrated by the examples 1 and 2 (samples 1 and 2 and comparative sample 3) of the opposed patent. Neither D2 nor D5 suggest the post-addition of that element. Adding this particular claim feature from document D4 can only be done with hindsight.

Therefore, the respondent's second approach also fails.

5.6.3 *Obviousness in view of D7*

In the respondent's view, D7 also discloses the post-addition step. Thus, by applying the teaching of D7 to D5, the skilled person would arrive at the claimed invention. The added non-calcined portion inevitably had to contain Co and La, as taught by D5.

The board is not convinced by this argument, for the following reasons:

Firstly, as D5 does not teach magnetoplumbite ferrites containing Co (see point 5.6.1 b) above), there is yet another step to be taken to arrive at the claimed invention when starting from D5, namely to replace Zn or Cd by Co. According to the argument of the respondent, substitution of (diamagnetic) Zn by (paramagnetic) Co, having a high K_1 value, was commonly

known to increase the intrinsic coercive force and therefore obvious. However, as already noted, the respondent's proposal of replacing Fe by Co would go against the explicit teaching of D5 according to which the presence of Zn or Cd is mandatory. The board is therefore not convinced that this is an approach the skilled person would have pursued in the expectation of successfully solving the problem posed.

Secondly, D7 in fact teaches a process comprising the step of mixing a part of the constituent elements of a magnetoplumbite magnet $MO.6Fe_2O_3$ (M being Ba, Sr, Ca) with a calcined portion of the said constituent elements. Thus essentially what is proposed is to omit the calcining step for some of the powder to be sintered (or, in other words, some of the powder may be used in an uncalcined state), without substantially negatively affecting the magnetic properties of the permanent magnet. The results of Table 1 demonstrate that the production of Ba ferrite sintered magnets (BH_{max}) remains essentially unaffected if up to approx. 40% of the constituents are added uncalcined (as powder A), whereas HBC (coercive force) drops by about 10%.

D7 does however not disclose or suggest that the magnetic properties (HBC, BH_{max}) of the sintered magnet can be improved by the post-addition step. Furthermore, as D7 is not concerned with magnets comprising the additional elements Co and R (R being selected from rare earth elements), it cannot suggest adding the additive elements Co and La in the post-addition step. There is a clear difference between the claimed process and D7 in that the latter teaches post-adding the same

elements, whereas the opposed patent adds just Co and La.

Therefore, the respondent's third approach is also not convincing.

5.6.4 Having regard to the product, i.e. the magnet obtained by the process according to claim 1, reference is made to points 5.5.1, 5.5.2 and 5.5.3 from which it is concluded

- that the problem of providing a magnet has been solved;
- that the composition of the magnet, in particular the replacement of Zn or Cd by Co, was not obvious.

As to the effect involved in the difference in preparation, the patent in suit discloses (see in particular example 1 and comparative example 3; Table 5) that samples prepared via the post-addition route have a smaller specific resistivity than the comparative examples prepared via the conventional route of D1 (addition of additives before calcination). This different magnetic property must be attributed to structural differences between the samples and is not suggested by the prior art.

5.6.5 *Obviousness in view of D1*

Another argument brought forward by the respondent in the written procedure, but not maintained in the oral proceedings, was based on document D1 representing the closest prior art, in view of D2, D3 or D4 (letter of 27 November 2008, page 15 ***et seq***.). However, because the claimed subject-matter was amended later on to

require the presence of Sr in an amount of 51 atomic-% or more, relative to A', and because D1 does not disclose Sr as a constituent of a magnetoplumbite ferrite magnet, this approach is, in the board's view, no more convincing than those previously discussed.

5.7 For all the above reasons, the subject-matter of process claim 1 of the main request involves an inventive step. The same holds for the subject-matter of claims 11 (the magnet) and claim 12 (the motor comprising the magnet).

The requirements of Article 56 EPC are met.

5.8 The dependent claims 2 to 10 represent preferred embodiments of the subject-matter of claim 1. They derive their patentability from claim 1 on which they depend.

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 the claims according to the main request as filed during oral proceedings, and a description and drawings to be adapted.

The Registrar: The Chairman:

C. Vodz G. Raths