BESCHWERDEKAMMERN DES EUROPÄISCHEN PATENTAMTS

BOARDS OF APPEAL OF THE EUROPEAN PATENT OFFICE

CHAMBRES DE RECOURS DE L'OFFICE EUROPEEN DES BREVETS

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File Number: T 0595/90 - 3.2.2

Application No.: 81 303 891.6

Publication No.: 0 047 129

Title of invention: Grain-oriented silicon steel sheets having a very low iron loss and methods for producing the same

Classification: C21D 8/12, H01F 1/16

D E C I S I O N
of 24 May 1993

Proprietor of the patent: KAWASAKI STEEL CORPORATION

Opponent: 01) Nippon Steel Corporation
02) Thyssen Stahl AG
03) Ugine Aciers de Chatillon et Gueugnon S.A.

Headword: Grain oriented silicon sheet/KAWASAKI

EPC Art. 56, 84, 113, 116 and 123(2)

Keyword: "Method claim; inventive step (no)" -"Product made by method also not inventive" - "Basis of decision - right to be heard - oral proceedings"

Headnote

1. Observations submitted as filed after the "adjournment" of the oral proceedings, which means the closing of the debate (in French "prononcer la clôture des débats" and in German "die sachliche Debatte für beendet erklären") are disregarded by the Board unless it reopens the debate. The reopening depends on the Board's discretion (point 1 of the Reasons).

2. A product which can be envisaged as such with all the characteristics determining its identity including its properties in use, i.e. an otherwise obvious entity, may become non-obvious and claimable as such, if there is no known way or applicable (analogy) method in the art to

make it and the claimed methods for its preparation are the first to achieve this and do this in an inventive manner (point 5 of the Reasons).

Case Number : T 0595/90 - 3.2.2

D E C I S I O N
of the Technical Board of Appeal 3.2.2
of 24 May 1993

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Decision under appeal : **Interlocutory decision of the Opposition Division of the European Patent Office dated 19 June 1990 concerning maintenance of European patent No. 0 047 129 in amended form.**

Composition of the Board :

Chairman : G.S.A. Szabo
Members : W.D. Weiß
M.K.S. Aúz Castro

Summary of Facts and Submission

I. European patent No. 0 047 129 was granted with effect of 24 April 1985 on the basis of European patent application 81 303 891.6, filed on 26 August 1981. The set of claims as granted is headed by the independent Claims 1 and 2 which read as follows:

"1. A grain oriented silicon steel sheet having an iron loss at $W_{17/50}$ of less than 0.90 W/kg, a Si content of from 2 to 4%, a thickness of from 0.15 to 0.25 mm, an average crystal grain size of from 1 to 6 mm, and a forsterite coating per one surface on its surfaces of from 1 to 4 g/m^2 per surface.

2. A method for producing a grain-oriented silicon steel sheet by providing a grain-oriented silicon steel sheet containing from 2 to 4% of Si, subjecting the sheet to one cold rolling or to two or more cold rollings with an intermediate annealing treatment to obtain a final gauge, subjecting the cold rolled sheet to decarburizing annealing, coating the sheet with an annealing separating agent, and then subjecting the sheet to final annealing, characterised in that the steel includes at least one of Se and S in an amount of from 0.010 to 0.035 and at least one of Sb, As, Bi and Sn in an amount of from 0.010 to 0.080% as inhibitor, the cold rolling is carried out so as to obtain a final gauge of from 0.15 to 0.25 mm, the final annealing is carried out so that a forsterite coating is formed on the steel sheet surfaces in an amount of from 1 to 4 g/m^2 per surface, and the secondary crystallized grain size is from 1 to

6 mm so that the resultant sheet has an iron loss at $W_{17/50}$ of less than 0.90 W/kg."

II. Three oppositions were filed on the main ground that the subject-matter of the European patent lacked an inventive step (Article 100(a) EPC). This objection was, *inter alia*, based on the following documents:

A(2) Journal of Applied Physics, Vol. 18 (1987), pages 1104 to 1108;
A(4) DE-A-2 923 374;
B(1) Nippon Steel Technical Report Overseas Number 4, (November 1973), pages 1 to 10;
B(3) DE-C-2 451 600.

III. In the opposition proceedings, the maintenance of the patent with an amendment in Claim 6, was requested as the main request and three auxiliary requests were filed additionally.

IV. By its decision of 19 June 1990, the Opposition Division decided that the documents according to the third auxiliary request met the requirements of the EPC and rejected the main, the first and the second auxiliary requests.

V. All the parties involved in the opposition proceedings have appealed against this decision in the following sequence:

Appellant I (Opponent III) on 21 July 1990;
Appellant II (Opponent II) on 16 August 1990;
Appellant III (Proprietor) on 17 August 1990;

Appellant IV (Opponent I) on 17 August 1990.

The Appellants I, II and IV paid the appeal fee on the respective same date. The appeal fee of Appellant III was received on 13 August 1990.

The respective Statements of Grounds were filed on 23 October 1990, on 18 October 1990, on 15 October 1990, and on 26 October 1990.

VI. The arguments of Appellant III (the Proprietor) presented in writing and during the oral proceedings of 6 May 1993 before the Board of Appeal can be summarised as follows:

Document B(1) had to be considered as the closest prior art. The difference of the product claim with respect to this document had to be seen in the feature that the patent suggested a forsterite coating of a certain weight in combination with a certain grain size to achieve an iron loss which was at least 5% lower than in any grain oriented silicon steel sheet commercially available at the filing date. In this context it had to be considered that the 9 mil sheet of ORIENTCORE HI-B reported in Table 1 of document B(1) was a test sample prepared on a laboratory scale and not a commercially available product.

Document B(1) did not teach that adjusting the sheet thickness to a size from 0.15 to 0.25 mm and the average grain size to a range from 1 to 6 mm was likely to provide a route to obtaining an iron loss $W_{17/50}$ of less than 0.90 W/kg. On the contrary, this document expressed

a prejudice against doing this by indicating that "9-mil sheets were manufactured for some time with the object of producing lighter-gauge or higher-grade sheets, but the industrial production of 9-mil sheets became deadlocked for two reasons - high cost and failure to obtain the desired low iron loss" and "Littmann states that the lowest iron loss is obtainable with a sheet thickness of 6 mils, this however is hardly realisable in commercial products from the points of both manufacture and use".

Document B(3) had to be seen as completely irrelevant, because its sole aim was to create a grain oriented silicon steel sheet having a high induction value of B8 without paying attention to any iron loss. Moreover, only thick gauge steels of about 0.3 mm were produced by this known method. Consequently, this document delivered no incentive to direct the method disclosed therein in a manner that resulted in a product with the claimed features.

VII. Against the patentability of the subject-matter of the contested patent the following arguments were in essence submitted by the other Appellants (Opponents).

Document B(3) was the closest prior art with respect to the method aspect of the patent in suit, because it disclosed the production of a high grade grain oriented silicon steel sheet using the same inhibitor system and forsterite as the major constituent of the glass coating. Although document B(3) did not disclose particular values for the iron loss it was clear that the skilled person who had a high induction material at

hand would strive to reduce its iron loss as much as possible. Before developing an investigation strategy of one's own, it was obvious to repeat systematically those experiments which had been proven to be successful, when the same problem had been solved for the historically older high grade material HI-B, and which had been reported in document (B(1). Potential prejudices expressed in this latter document reflected the knowledge of the year 1973 and, at the valid date of the contested patent, had been overcome by intermediate knowledge. Document A(4), for instance, demonstrated that methods had existed at the relevant date of the contested patent which had allowed to produce thin high grade grain oriented silicon steel sheet having a low iron loss on an industrial scale.

The features contained in the granted dependent Claims 3 to 7 were at least implicitly disclosed in document B(3).

The disclosure of all these documents had to be seen before the background of the disclosure of document A(2), which was not to be seen as a separate document but reflected basic general knowledge of persons skilled in the art of producing grain oriented steel sheets.

VIII. The Appellant III (Proprietor) requested that the decision under appeal be set aside and that the patent be maintained on the basis of Claims 1 to 7 as annexed to the decision under appeal as the main request.

On an auxiliary basis it requested that the patent be maintained with:

1. Claims 1 to 7 filed as a first auxiliary request, also annexed as such to the decision under appeal;

2. Claims 1 to 7 filed on 27 March 1993 as a second auxiliary request with the amendment that the word "including" in the seventh line of Claim 1 is replaced by the words "having been made using";

3. Claims 1 to 6 as annexed to the decision under appeal as a third auxiliary request; or

4. one single claim filed on 27 March 1993 as a fourth auxiliary request.

Claim 1 according to the main request is identical with the granted Claim 1 cited above.

Claim 2 according to the main request and according to the first and second auxiliary requests as well as Claim 1 according to the third auxiliary request are identical with the granted Claim 2.

Claim 1 according to the first auxiliary request is identical with the granted Claim 1 except that the upper limit for the grain size has been reduced to 5.8 mm.

Claim 1 according to the second auxiliary request corresponds to its granted version to which has been added:

"said steel having been made using at least one of Se and S in an amount of from 0.010 to 0.035% and at least

one of Sb, As, Bi and Sn in an amount of from 0.010 to 0.080 as inhibitor".

Claim 1 according to the fourth auxiliary request corresponds to granted Claim 2 to which has been added:

"the desired secondary recrystallised grain size of 1 to 6 mm being obtained by one of the following methods (a) to (d) or a combination of at least two of them, with the proviso that when the combined methods include the same step, that step is not carried out more than once;
(a) adjusting the carbon content in the steel sheet prior to the final cold rolling so that it is from 0.020 to 0.060%, maintaining a temperature of from 850 to 1,100°C for at least 0.5 minute prior to the final cold rolling, then cooling the heated sheet over a temperature range of from 700 to 200°C at a cooling rated of higher than 150°C/min, and effecting the final cold rolling at a reduction of from 55 to 85%,
(b) adjusting the carbon content in the steel sheet prior to the final cold rolling so that it is from 0.020 to 0.060%, effecting the final cold rolling at a reduction rate of from 55 to 85%, and adjusting the steel sheet temperature in the final cold rolling so that its from 50 to 400°C,
(c) effecting the final cold rolling at a reduction rate of from 55 to 85%, ensuring that the rate of temperature increase in the decarburising annealing is higher than 100°C/min over a temperature range of from 450 to 750°C, and keeping the steel sheet in wet hydrogen in a temperature range of from 780 to 880°C for from 1 to 15 minutes,

(d) keeping the cold rolled steel sheet at a temperature of from 900 to 1,050°C for from 0.1 to 15 minutes after decarburising annealing and then completing secondary recrystallisation at a temperature of from 800 to 900°C before the final annealing."

The other three appellants requested that the decision under appeal be set aside and that the European patent be revoked.

IX. At the end of the oral proceedings the Board reserved its decision.

X. On 8 May 1993 the Board received further observations from Appellant I (Opponent III) and on 25 May 1993 from Appellant III (Proprietor of the patent).

Reasons for the Decision

1. *Admissibility and other procedural questions*

The appeals are admissible.

The observations filed by two parties, i.e. one of the Opponents and the Proprietor of the patent, on 8 and 25 May 1993 are disregarded because they were filed after the "adjournment of the oral proceedings". The adjournment of oral proceedings which means the closing of the debate (the French version, "prononcer la clôture des débats", and the German version, "die sachliche Debatte für beendet erklären" are clearer in this respect) normally terminates the possibility of further

submissions. Observations submitted thereafter could only be taken into account if the Board reopened the debate (Article 113 EPC) which depends on its discretion. The Board sees no reason for this as the parties were given ample opportunity to present all the arguments they thought relevant. Besides the submissions do not contain any matter which had not been discussed during oral proceedings.

2. *Amendments*

Only Claim 1 of the first auxiliary request was subject to an objection under Article 123(2) EPC due to the upper limit of 5.8 mm for the average grain size. The Appellant III (Kawasaki) asserted that this value could be deducted as a favourable upper limit from Table 1 of the contested patent.

In Table 1 the upper limit of 5.8 mm for the average grain size appears only once in connection with a respective lower limit of 2.8 mm and with the particular choice of certain amounts of MnSe and Sb as grain growth inhibitors. The passing ratio of 90% which is attained by this particular constellation of parameters is, however, equal to the passing ration which, according, to the same Table 1, was attained for the choice of MnSe and Sb and Sn as grain growth inhibitors and an average grain size of 2.8 to 6.2 mm.

Table 1, in this respect, rather suggests that small variations of the grain growth inhibitors have a higher influence on the quality of the product than the variation of the upper limit of the average grain size

between 5.8 and 6.2 mm. Table 1 is, therefore, no basis for a general disclosure of the value of 5.8 mm as favourable upper limit for the range of the average grain size.

Consequently, Claim 1 according to the first auxiliary request does not meet the requirements of Article 123(2) EPC and the request itself must thereafter be rejected.

All the other claims are not open to an objection in this respect.

3. *Novelty*

The examination of the documents cited during the proceedings has revealed that the features of the product Claim 1 and the method Claim 2 according to the main request are not fully disclosed in any of them. It follows that the product and the method are novel over these documents within the meaning of Article 54 EPC. Since the independent claims according to the auxiliary request are further restricted in scope, this statement also applies to them.

4. The set of claims according to the main request is headed by two independent claims, Claim 1 being directed to a product and Claim 2 to a method. The independent method claim is identically contained also in the sets of claims according to the first and third auxiliary requests.

The Appellant III (Proprietor) admitted in his statement that the specified steps of the independent method

Claim 2 according to the main request would indispensably arrive at a product meeting all the features of the product Claim 1 according to the main request, when being fully carried out by a skilled person who is equipped with the usual general knowledge for the production of high-grade grain oriented steels, at least with the further guidance of the description. The two claims are therefore implicitly linked and coterminous.

5. *Product claim*

Document B(1) is considered to be the closest state of the art with respect to the subject-matter of the product Claim 1.

This document originated from a newly developed method to produce silicon steel sheet (ORIENTCORE HI-B) with a high degree of a cube-on edge crystal orientation and hence with a high value of magnetic induction. IT is well known and undisputed by all the parties that ORIENTCORE HI-B material has a silicon content of about 3%. Induced by the requirements of the users, the manufacturer of such magnetic steel sheet was inevitably confronted with the problem to minimise the iron loss of the steel sheets without losing the high degree of crystal orientation. Document B(1) is the comprehensive report about investigations performed with the aim to find out which parameters affected these qualities. The conclusions are as follows:

- The iron loss is dependent on sheet thickness and has a minimum between 5 and ten mils (0.127 and

0.254 mm), provided that grain size, purity and degree of orientation are equal in each sample (Figure 12, Table 2).

- The iron loss is decreasing with decreasing grain size for grain sizes between about 0.5 to about 10 mm and is increasing sharply at still lower grain sizes, provided that purity, degree of orientation and thickness of the samples are equal (Figures 9A and 9B, and page 5, right column).

- The iron loss is dependent on the tensile stress exerted on the surface of the sheet by a glass film (page 5, right column). For an average grain size of 3.5 mm the iron loss has a minimum at a tensile stress between 0.3 and 0.5 kg/mm^2 (Figure 10).

Consequently, these results, which were performed on a laboratory scale, cover the teaching to a person skilled in the art to aim at a grain oriented steel sheet having a thickness between 0.127 and 0.254 mm and a grain size in the middle of the range of 0.5 to 10 mm and then choose the thickness of the glass film such that the tensile stress it exerts on the surface of the sheet minimises the iron loss. He must, however, achieve this while maintaining an as high a degree of orientation as possible. The latter condition is not only essential to guarantee a high flux density but also to maximise the influence of the tensile stress (applied by the glass film) on the reduction of the iron loss (Figure 3).

During the oral proceedings, there was agreement between the parties that forsterite has been the traditional

material for the glass film separator formed on the surface of high grade silicon steel sheet. It was still used immediately before the priority date of the patent in suit (see Appendix I to the Grounds of Appeal of Appellant III/Proprietor), for instance as so-called "mill glass" coating having a thickness of 1 µm corresponding to 2.58 MPa (see the above-mentioned Appendix I). Therefore, the results displayed in Figure 4 of document B(1) are obtainable with a forsterite film of slightly less than 1 µm and the maximum tension effect which requires a stress of 0.4 Kg/mm^2 ((B1), page 5, last paragraph) is obtainable with a slightly thicker forsterite film.

Consequently, there is no reason why a skilled person should not interpret the word "glass film" used in document B(1) in the usual manner as to mean a forsterite film with a thickness in the usual range which means a glass film with the specification given in Claim 1.

Following these considerations, the subject-matter of the product Claim 1 according to the main and first auxiliary requests differs from this desirable product disclosed by document B(1) in that it specifies that the iron loss $W_{17/50}$ should be less than 0.90 W/kg.

In view of the above, this difference corresponds to the known desideratum and is equivalent to the remark in document B(1) that the degree of orientation should be maintained as high as possible when the three parameters thickness of the sheet, grain size and thickness of the coating are adjusted to their optimum values. It follows

that the claimed product only has properties which were fully predicted, and envisaged, i.e. the matter is obvious **as such**. This applies to all product claims in the main and the first three auxiliary requests.

However, at the date of the publication of document B(1) (1973), this desideratum, *prima facie*, was not yet actually achieved at least in an industrial scale, because this document is quite clear in mentioning that the reported effects, which had been verified on a laboratory scale were hardly realisable in commercial products with sheet thicknesses of about 9 mil (0.23 mm) "from the points of both manufacture and use" (page 7, left column under Figure 11). But according to document (A2) (page 1108, Conclusion), this handicap was taken more as a challenge by the skilled metallurgist rather than an insurmountable prejudice.

The subject-matter of the product claim thus is only concerned with a known desideratum and not with a new problem. The allowability of Claim 1 according to the main and first auxiliary request is then linked to the answer to the question whether the desideratum disclosed by document B(1) was still unachievable at the priority date of the patent in suit or whether there was an obvious way leading to it. This is relevant since it is the view of the Board that a product which can be envisaged as such with all characteristics determining its identity together with its properties in use, i.e. an otherwise obvious entity, may become nevertheless non-obvious and claimable as such, if there is no known way or applicable (analogy) method in the art to make it and the claimed methods for its preparation are

therefore the first to achieve this in an inventive manner. Conversely, should the method claims not be allowable because their subject-matter is obvious, then the product claim linked to them in the respective request could not be allowable either on the basis of the method alone. The allowability of the method claims must therefore also be investigated.

6. *Closest State of the Art*

6.1 The Board considers document B(3) to be the closest state of the art with respect to the subject-matter of the method Claim 2 according to the main request.

This document (the claims) discloses a method for producing a grain oriented steel sheet with less than 4% of Si, in particular between 2.3 and 3.28% Si (Table 2), which starts from a steel including at least one of Se and S in an amount of from 0.005 to 0.1% and at least one of the two Elements (Xi) and (Xj), Xi representing at least one of the elements As, Bi, PB, P and/or Sn in a total amount of 0.015 to 0.4% and (Xj) representing Ni and/or Cu in a total amount of 0.2 to 1.0%. Moreover, the starting material may contain 0.005 to 0.2% Sb. In particular B(3) discloses in its Tables 1 and 2, respectively, the exemplary compositions A (0.003% S, 0.017% Se, 0.03% As, 0.03% Sb), B (0.004% S, 0.016% Se, 0.04% As), C (0.003% S, 0.017% Se, 0.05% Bi), 1 (0.010% S, 0,021% Se 0.031% As), 6 (0.003% S, 0.020% Se, 0.04% Bi), 12 (0.011% S, 0.022% Se, 0.010% Sb, 0.020% Sn), and 13 (0.004% S, 0.020% Se, 0.028% Sb, 0.032% Sn).

This starting material, after having been hot rolled to an intermediate gauge, is subjected to two or more cold rollings with an intermediate annealing treatment to obtain a final gauge. The cold rolled sheet is subjected to a decarburising annealing and then to a final recrystallising annealing.

After the decarburising annealing and before the final annealing, the cold rolled sheet is coated with an annealing separating agent consisting mainly of magnesia (B(3), column 10, lines 30 to 45). The Board is in agreement with all the parties that this separating agent will automatically be transformed into a forsterite coating during the final annealing.

Although the test sequence the results of which are reported in Table 1 and in Figures 3 and 4 of document B(3) has been carried out using sheet samples with a final thickness of 3 mm to make the results comparable, the disclosure of this document is not restricted to this final thickness. According to the teaching of document B(3), the reduction during the final cold rolling step is of major importance and should be chosen between 40 and 80% (Claim 1). The thickness of the hot rolled sheet (column 9, lines 44 to 49) and the reduction during the first cold rolling step column 10, lines 7 to 10) are of minor importance and may vary between 2 to 4 mm and 30 to 80%, respectively. The specific respective value of these two parameters is selected within these relatively large ranges in dependence on the desired final thickness (column 9, line 55, to column 10, line 10).

6.2 *Problem and Solution*

In document B(3) a new inhibitor system is presented to the public which aims at replacing AlN used before as an inhibitor to selectively favour the growth of the correctly oriented grains. The new inhibitor system is said to allow a more economic production of high-grade electric steel sheets on a large industrial scale than does the AlN (column 2, lines 29 to 45).

Although it is the primary aim of document B(3) to obtain a material with a high magnetic induction, it is also made quite clear that this quality should go together with a low iron loss (the paragraph bridging the columns 1 and 2). Therefore the "negligence" that this document does not report any value for the iron loss of the steel sheet fabricated using this new inhibitor system is obviously due to the fact that the authors of document B(3) had not yet had the time to look at all important aspects of their new development.

Starting from document B(3) as the closest prior art, one of the most urgent problems to be solved is, therefore, to optimise this known process in a manner that the final steel sheet has an iron loss which is as low as possible (less than 0.90 W/kg) without losing the high grain orientation, and hence induction, already achieved.

In its method aspect according to the main request, the contested patent claims to solve this problem by the combination of the following features by which the

subject-matter of Claim 2 differs from the disclosure of document B(3):

- The cold rolling is carried out so as to obtain a final gauge of from 0.15 to 0.25 mm;

- the final annealing is carried out so that the forsterite coating which is formed on the steel sheet surfaces amounts to from 1 to 4 g/m^2;

- the final annealing is carried out that the secondary crystallised grain size is from 1 to 6 mm.

The feature "that the resultant sheet has an iron loss at $W_{17/50}$ of less than 0.90 W/kg" was confirmed by Appellant III (Proprietor) to be the inevitable result of the other method features provided that these are carried out by a person skilled in the art using his ordinary general knowledge and skill and further being guided by the description of the patent in suit.

6.3 *Inventive Step*

When the new grain growth inhibitor system according to document B(3) had been presented to the public, the person skilled in the production of grain oriented silicon steel sheets found himself in a position in which he had been at least already twice in the past. New methods had been developed, at least on a laboratory scale, to create silicon steel sheet with a high degree of cube-on-edge crystal orientation and hence with a high value of magnetic induction. Induced by the requirements of the users, the manufacturer of such

magnetic steel sheet was inevitably confronted with the problem to minimise the iron loss of his sheets without losing the high degree of crystal orientation. Therefore, systematic tests had to be performed to find out by which parameters these qualities were affected.

In 1967, the results of a classical investigation in this respect had been reported by the review document A(2) the disclosure of which is rated as part of the general knowledge in this technical field.

A similar investigation was carried through, when the grain growth inhibiting properties of AlN had been detected and the new grain oriented sheet product, known under the trade name ORIENTCORE HI-B, which exhibited a still higher degree of grain orientation and hence a higher value of magnetic induction, had been developed on this basis. Document B(1) is the comprehensive report about these investigations disclosing the conclusions enumerated under point 5 above.

The Board cannot recognise any prejudice that could have stopped a person skilled in the art, who wanted to optimise the iron loss values of the high grade magnetic steel sheets produced by using the new inhibitor system disclosed in document B(3) to repeat, at least as a first approach, the same systematic experiments which according to document B(1) - and there before according to document A(2) - had proved to be apt for finding out which parameters influenced the iron loss values of the new class of magnetic material.

Although document B(1) is quite clear in mentioning that these effects, which had been verified on a laboratory scale were hardly realisable in commercial products with sheet thicknesses of about 9 mil (0.23 mm) "from the points of both manufacture and use" (page 7, left column under Figure 11, see also document A(2), page 1108, Conclusion), this remark cannot be taken as a prejudice which was still valid at the priority date of the patent in suit. Document A(4) proves that, in 1979, methods had been developed which allowed to produce 0.225 mm thick high grade silicon sheets having an iron loss of less than 0.90 watt/kg.

Consequently, the subject-matter of the method Claim 2 according to the main request is to be considered as the inevitable technical conclusion to be drawn from the results of the sequence of tests the performance of which is obvious when applying the experiments disclosed in B(1) on silicon steel sheet using the inhibitor system disclosed in document B(3).

In particular, the Board cannot acknowledge that the measure to form a forsterite coating in an amount of 1 to 4 g/m^2 per surface involves an inventive step.

Forsterite is the classical main constituent of the glass coatings formed from the separator composition during the final annealing. The Board is in agreement with all the parties that forsterite is also formed when carrying out the method disclosed in document B(3) (column 10, lines 30 to 45). The patent in suit (page 3, lines 11 to 13) states that a minimum of 1 g/m^2 forsterite is indispensable to maintain the insulation

and to obtain a good face coating. It would not be comprehensible, why the skilled person should use another composition and quantity for the glass coating when already the routine coating proves to apply a tensile stress to the sheet surface which suffices to minimise the iron loss value.

In summary, the Board, therefore, reaches the conclusion that the subject-matter of Claim 2 according to the main request can be deducted from the prior art in an obvious manner and thus does not involve an inventive step in the sense of Article 56 EPC.

6.4 The method according to Claim 2 of the main request, when carried out by a person skilled in the art, results in products which meet the features of the product Claim 1 according to the main request. Following the considerations under point 5 above, the respective Claim 1 does not involve an inventive step either.

The main request is therefore not allowable.

7. The first auxiliary request is not allowable, because its independent Claim 1 does not meet the requirements of Article 123(2) EPC (see point 2 above).

Claim 1 of the second auxiliary request differs from the Claim 1 according to the main request only by the feature that the product has been produced using those grain growth inhibitors, the use of which is also a feature of the method Claim 2 according to the main request. Since these grain growth inhibitors are no longer contained in the final grain oriented steel sheet

but are removed during the purifying final anneal, their usage can no longer be detected at the final grain oriented steel sheet. Consequently, this feature has no additional discriminating effect.

Moreover, the independent Claim 2 according to the second auxiliary request and the independent Claim 1 according to the third auxiliary request are identical to Claim 2 of the main request.

Since, therefore, the above considerations for the main request are valid for these requests as well, the second and third auxiliary requests are also not allowable because of lack of inventive step.

8. Therefore, the only claim according to the fourth auxiliary request has to be considered.

8.1 This method claim is also based on Claim 2 according to the main request and includes the further restriction that "the desired secondary recrystallised grain size being obtained by one of the following methods (a) to (d) or a combination of at least two of them, with the proviso that when the combined methods include the same step, that step is not carried out more than once", the features of the methods (a) to (d) being enumerated thereafter. The steps of the methods (a) to (d) correspond to the features of the dependent Claims 3 to 6 according to the main request.

Due to the alternative construction of this claim, it can only be allowable, if all the four options prove to meet the requirements of the EPC. In other words, if one

of these options proves not to meet these requirements, the whole claim is not allowable.

8.2 Option (b) consists of the steps

- adjusting the carbon content prior to the final cold rolling so that it is from 0.020 to 0.060%,

- effecting the final cold rolling at a reduction rate of from 55 to 85%, and

- adjusting the steel sheet temperature in the final cold rolling so that it is from 50 to 400°C.

Document B(3) starts from a silicon steel containing less than 0.06% carbon (column 3, first paragraph). The carbon contents of the test samples vary from 0.025 to 0.042% (Table 2). The method disclosed in document B(3), in its phase between starting material and the last cold rolling step, is carried out conventionally that is to say it includes only steps which have no decarburising effect. It is a generally known fact that the amount of carbon lost during such a conventionally guided process before the decarburising anneal close to its end is generally 0.005% and less. Consequently, document B(3) implicitly discloses that all the test samples, before the final cold rolling step, had a carbon content which was adjusted well within the range of 0.02 to 0.06% claimed according to option (b).

According to document B(3), the reduction of the final cold rolling step should be 40 to 80% (Claim 1). The reduction rates actually chosen for the test samples

vary from 55 to 75% , and thus lie well within the range of 55 to 85% claimed according to option (b).

The rolls of the cold rolled stands are intensely cooled to prevent them from bulging and to maintain an equal thickness of the cold rolled steel sheet. It is well known that, nevertheless, the resultant steel temperature generally runs between 65 and 120°C and even higher depending on the degree of reduction. Consequently, the steel sheet which is subjected to the final cold rolling step as disclosed in document B(3) will unavoidably assume a temperature well within the temperature range of 50 to 400°C.

Following the above considerations, the features of option (b) according to the fourth auxiliary request are also met by the method disclosed in document B(3). The subject-matter of this claim does, therefore, not involve an inventive step either.

9. In summary, the Board comes to the conclusion that all the requests lack at least one of the requirements for a patentable invention according to Article 52(1) EPC.

Order

For these reasons, it is decided that:

1. The decision under appeal is set aside.

2. The patent is revoked.

The Registrar:

The Chairman:

S. Fabiani

G. Szabo