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D E C I S I O N
of 22 October 2001

Case Number: T 1041/98 - 3.2.2

Application Number: 92116467.9

Publication Number: 0534460

IPC: C22C 38/10

Language of the proceedings: EN

Title of invention:
Iron-nickel-cobalt alloy for a shadow mask

Applicant:
Yamaha Metanix Corporation, et al

Opponent:
-

Headword:
-

Relevant legal provisions:
EPC Art. 54, 83

Keyword:
"Sufficiency of disclosure (yes)"
"Novelty (yes)"

Decisions cited:
-

Catchword:
-

Case Number: T 1041/98 - 3.2.2

D E C I S I O N
of the Technical Board of Appeal 3.2.2
of 22 October 2001

Appellant:

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Decision under appeal: **Decision of the Examining Division of the European Patent Office posted 24 June 1998 refusing European patent application No. 92 116 467.9 pursuant to Article 97(1) EPC.**

Composition of the Board:

Chairman: W. D. Weiß
Members: R. Ries
J. C. M. De Preter

Summary of Facts and Submissions

I. The appellant (applicant) lodged an appeal against the decision of the Examining Division posted on 24 June 1998 to refuse the European patent application No. 92 116 467.9.

The Examining Division held that the application did not satisfy the requirements of Articles 83 EPC (insufficient disclosure) or alternatively if it did, that the claimed subject matter failed to meet the requirements of Article 54 EPC (lack of novelty) having regard to documents

D2: US-A-4 853 298 and

D3: US-A-5 026 435.

During the examination procedure, document

D1: EP-A-0 174 196

had also been considered.

The claimed Fe-Ni-Co-Mn alloy composition being known per se from document D3, the Examining Division argued that each process known in the art and meeting the process conditions defined in the description of the application must inevitably result in the same microstructure defined in claim 1, or if not, an essential process feature for carrying out the invention was missing in the application. Given that the applicant failed to identify such a distinguishing process step, it was concluded that either the requirements of Article 83 were not met or, if the same texture of the cold rolled thin Fe-Ni-Co-Mn plate actually resulted from the known process, the claimed thin rolled plate lacked novelty with respect to the product given in document D3.

II. In its grounds of appeal, the appellant additionally referred to the documents:

D4: "Crystal Aggregation", issued in Japan 1984, pages 133, 134 and the translation into English and

D5: "Metals Handbook", 8th Edition, volume 8, American Society for Metals, 1973, pages 229 to 232

The appellant requested that the decision under appeal be set aside and a patent be granted on the basis of amended claims 1 and 2 according to the request of 9 July 2001.

Claims 1 and 2 read as follows:

"1. A rolled thin plate of an Fe-Ni-Co alloy used for a shadow mask characterised by an alloy composition consisting of 28 to 34% by weight of Ni, 2 to 7% by weight of Co, 0.1 to 1.0% by weight of Mn, 0.10% by weight or less of Si, 0.01% by weight or less of C, and Fe with indispensable impurities in balance, an average grain size of 30 μm or less and 60 to 95% of crystal grains which are accumulated in the {100} planes and are oriented in a range of ±5 to 45 degrees, deviated from the ideal plane direction {100}[001] with respect to a rolling direction."

"2. A rolled thin plate as claimed in claim 1, wherein said 60 to 95% of crystal grains are oriented in a range of ±10 to 30 degrees deviated from the ideal orientation {100}[001]."

IV. The appellant argued as follows:

The thin rolled plate according to the present invention is defined by (i) the composition of the alloy, (ii) the grain size and (iii) the crystal accumulation or texture. Due to these physical properties, the rolled plate can be provided with holes having a high degree of circularity by chemical etching. If the apertures are not properly formed, the plate is unsuitable for the production of high precision shadow masks. Thus, the present invention basically resides in the thin plate product rather than in a process, as erroneously alleged by the Examining Division.

As set out in detail in the specification, the grain size and crystal accumulation are achieved by forming the cast Fe-Ni-Co-Mn alloy into a thin plate through a series of hot rolling, cold rolling and annealing steps and, more importantly, by choosing the appropriate reduction rates and annealing temperatures. According to documents D4 and D5 - which both represent the basic metallurgical knowledge - the claimed cubic orientation of the plane direction {100}[001] is well known in the art and can be easily obtained by selecting a Fe-Ni material having a low amount of impurities, by performing a high degree of cold working and by annealing at a relatively high temperature (cf. D4). Specific texture control on the final product is generally performed by using the "pole Figure technique" which is described for example in

"Metals Handbook" (document D5). Hence, there is no need to add further statements to the process steps described in the present application, since the invention is sufficiently disclosed to be carried out by a skilled person.

Even if the composition of the alloy and some process factors of the claimed alloy are disclosed in documents D2 and D3, no control is applied in this prior art to the grain size and the crystal orientation of the final plate product, and neither document mentions the need to form holes having a high degree of circularity by etching as does the invention. Hence the claimed subject is also novel.

Reasons for the Decision

1. The appeal is admissible.

2. *Amendments (Article 123(2) EPC)*

The combination of technical features according to claim 1 now on file is disclosed in originally filed claim 1 and in the description, page 3, lines 30 to 51 of the A1 publication (page 6 paragraph 3 to page 7, first paragraph of the documents as originally filed). Claim 2 corresponds to former claim 2.

Hence, there are no formal objections to the claims.

3. *Clarity (Article 84 EPC)*

Claim 1 defines the specific alloy composition, the grain size and the crystallographic orientation of the grains of the claimed rolled thin plate. The relative term "thin" has to be interpreted in the light of the intended use of the plate for a shadow mask and, therefore, does not introduce an unclarity. Hence, the claims are clear and concise, and there is ample support by the description. The requirements of Article 84 EPC are, therefore, met.

4. *Disclosure of the invention (Article 83 EPC)*

In the view of the Examining Division, the applicant has failed to show which specific process steps actually lead to the claimed microstructure which, according to the applicant, is to be different from that of the rolled plate produced by the process shown in document D3. The Examining Division, therefore, concluded that the invention was not sufficiently disclosed since two different products could not be produced by subjecting the same alloy composition to the same process, unless a specific process step not disclosed in the application was resorted to.

Apart from the requirement that the claimed subject matter must be novel and involve an inventive step, the requirements for sufficiency of disclosure and repeatability of the invention belong to the basic prerequisites for the grant of a patent. In particular, the disclosure of the application as a whole must be sufficient to enable the skilled reader to carry out the invention.

The description of the preferred embodiment of the present application specifies on page 3, lines 51 to 58 that the rolled plate exhibiting the claimed grain size and microstructure can be produced by hot working, cold rolling and annealing. It is emphasized that recrystallization annealing after cold working at a reduction rate of 60% or higher raises the degree of accumulation of the grains in the ideal orientation {100}[001]. By further cold working following this annealing step, the accumulation is dispersed into different directions while maintaining the accumulation in the {100} planes, the degree of dispersion being freely controllable by the proper choice of the cold working rate. More detailed information about the appropriate temperature ranges for hot working and annealing as well as the reduction rates for cold working is found on page 4, lines 45 to 50 of EP-A-0 534 460. A similar technical information is given in document D4 which recommends cold working rates of 80 to 95% and high temperature annealing of Fe-50Ni alloys in order to obtain a crystal aggregation on plane direction {100}[001]. Based on this specific teaching, the expert is aware of the effect of the various process parameters he has to pay particular attention to in order to obtain the desired properties. Even if the expert encounters occasional lack of success in obtaining the desired microstructure despite strict adherence to the prescribed limits for the annealing temperature and working rates, this would not automatically result in the conclusion that the technical teaching is insufficiently disclosed. Given that the effect of these process parameters is well known in the art and described in the specification, the skilled person can be expected to carry out a reasonable amount of trial and error to find out the optimal combination of process parameters which bring about the desired microstructure. According to the description (see EP-A-0 534 460, page 6, line 46 to page 6, first line), the texture control of the final product, i.e. the grain size and crystallographic orientation, can be carried out by X-ray diffraction tests, in particular by using the "pole-Figure technique" which is common in the art for examining sheet textures (cf. Figures 2 to 5 of the specification, and document D5, page 231, Figures 6 to 8 and page 232). It is noted in this context that documents D4 and D5 are basic handbooks which represent the common general knowledge of the metallurgist. The Board, therefore, concludes that the application as a whole and taken together with the expert's common general knowledge represented by documents D4 and D5 and cited in the appeal proceedings is sufficiently clear and complete to enable a skilled worker in the art to carry out the invention without additional instructions.

5. *Novelty*

Therefore, it has to be examined whether in document D3 the same process steps as claimed have been used and whether the rolled plates resulting from these processes exhibit the same properties.

Document D3 is concerned with a process for producing Fe-Ni-Co lead frames of semiconductor devices having enhanced strength without impairing solderability and platability (cf. D3, column 2, lines 11 to 14). In contrast to conventional Fe-Ni-Co alloys which are strengthened by adding strengthening components to a single phase structure of austenite or martensite, the method steps according to document D3 result in a final thin Fe-Ni-Co-Mn plate product that is strengthened by a two-phase austenitic-martensitic structure. Among the exemplifying alloys given in Table 1 of D3, the composition of samples No. D, E and I completely falls within the ranges defined in the application. After forging at 1100° to 1150°C and hot rolling to a thickness of 3 mm, the rolled products were subjected to a 1 hour solid solution heat treatment at 1000°C followed by water cooling, and thereafter cold rolled to a thickness of 0.35 mm (corresponding to a reduction ratio of 88,3%). The samples were then subjected to a sequence of treatment steps which includes a solid-solution heat treatment at 750°C, cold rolling down to 0.1 mm (71% reduction ratio) and final annealing at 650°C (cf. D3, column 4, lines 53 to 65).

It is noted that the process described in the present application does not specify a 1 h-1000°C solid solution heat treatment followed by a quenching step as does document D3. Moreover, the reduction ratio combined with the annealing temperatures selected according to document D3 aim at producing a two-phase austenitic martensitic structure to impart a high strength to the final product. As is apparent from Table 2 of D3, the amount of austenite is between 87% (E) and 93% (I), and the tensile strength (TS) is between 92 and 103 kg/mm^2. Since, however, no information is given in document D3 about the 0.2% yield point (YS), it can be concluded that formability is there not considered to be essential. Moreover, the average coefficient of thermal expansion (CTE) between room temperature and 300 °C varies between 6.8 - 7.6 x10^{-6} 1/°C compared to 2.6 - 12.1 x10^{-7} 1/°C in the present application.

Although the application at issue is silent about the phase structure, it is evident from Table 2 that the claimed Fe-Ni-Co plate exhibits a 0.2% proof stress (yield point) of about 25 kgf/mm^2. A low value for the YS is, however, important since the lower the 0.2% proof stress, the better the formability. In addition, the CTE between 2.6 to 12.1 $x10^{-7}$ 1/°C determined in the specification is much lower than the CTE given in document D3. Such a small coefficient of thermal expansion is indispensable in order to reduce the degree of "doming" (cf. the A1 publication, page 2, lines 10 to 18). These considerations and the fact that the plates according to D3 are provided for purposes different from those claimed, lead to the conclusion that the physical and mechanical properties of the rolled plate produced according to document D3 are also different from the properties of the rolled plate aimed at and achieved by the process described in the present application.

Moreover, document D3 fails to disclose anything about the grain size and the crystallographic texture of the rolled plate, and no measures have been taken to improve the etching characteristics which represent the key features of the present application (see EP-A-0 534 460, page 3, lines 26 to 50). The subject matter of claim 1 is, therefore, novel vis-à-vis the disclosure of document D3.

Document D2 discloses an austenitic Fe-Ni-Co-Mn alloy composition falling within the claimed ranges and exhibiting essentially the same CTE (0.1 to 4.5 x 10^{-7} 1/°C; see Table I to IV). The low expansion alloys disclosed in document D2 are to be used for the production of precision optical devices, microscopes or laser gyroscopes. Moreover, the process used to produce the material according to document D2 does not include cold rolling - annealing sequences. Document D2 is also silent about the grain size and the crystallographic structure of the known material. Therefore, the subject matter of claim 1 is novel with respect to document D2.

6. *Inventive step*

During substantive examination, document D1 also was considered. In the Board's view, this document represents the closest prior art, since - like the present application - it is concerned with Fe-Ni-Co alloys having a high formability and good etching characteristics so that the material is particularly suitable for the production of shadow masks. Even the problems of "doming" and "spring back" associated with a poor thermal expansion coefficient as well as the etching characteristics and formability of the alloy are there addressed (cf. D1, page 1 to 2, paragraph 1; page 2, last line to page 3, paragraph 1). A favourable grain size was found to be in the range of 2000 to 40000 grains/mm^2 (corresponding to a grain diameter of about 5.6 to 25 µm) so that upon etching the apertures are properly formed (cf. D1, page 3, paragraph 3). By the addition of chromium to the Fe-Ni-Co alloy in the range of 0.3 to 10%, the 0.2% yield point can be decreased to below 24 kg/mm2 after annealing, although as a side effect an increased coefficient of expansion has to be tolerated with increasing Cr-amounts (cf. D1, page 5, line 19 to page 6, line 26).

The subject matter of claim 1 differs from the disclosure of document D1 in that the Fe-Ni-Co alloy does not comprise chromium and that the plate made therefrom exhibits a specific crystallographic orientation.

Starting from document D1, the problem underlying the present application, therefore, resides in further improving the overall properties of the rolled plate product with respect to its intended use as a shadow mask, i.e. in particular to further reduce the coefficient of thermal expansion and to significantly improve the etching factor which means that the etched openings exhibit a high degree of circularity.

The solution to this problem consists in selecting a Fe-Ni-Co-Mn alloy within narrow elemental limits and treating this alloy in a way so that the final thin rolled plate exhibits a crystallographic orientation as defined in claim 1.

Document D1 is silent about the crystallographic orientation of the grains in the known plate product. Hence the skilled worker does not find an inducement in this document to aim at a specific crystallographic structure. The teaching in D1 to replace chromium by increasing amounts of manganese has no bearing on the matter, since this does not mean that such a modified alloy composition actually affords the same properties as required from the rolled thin plate claimed in the present application.

Given that none of documents D1 to D3 addresses the problem of "circularity of the etched openings" or even describes the crystallographic orientation of the grains, these documents could not be helpful in solving the above mentioned problem. The claimed subject matter, therefore, also involves an inventive step within the meaning of Article 56 EPC.

7. Since the application and the invention to which it

relates meet the requirements of the EPC, a patent is to be granted according to the request of the appellant.

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 in the following version:

Description: pages 1 to 15 as originally filed

Claims: 1 and 2, filed with letter of 9 July 2001

Figures: 1/7 to 7/7 as originally filed.

The Registrar: The Chairman:

V. Commare W. D. Weiß