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**D E C I S I O N**  
**of 13 October 2005**

**Case Number:** T 0306/03 - 3.2.02

**Application Number:** 97660095.7

**Publication Number:** 0826785

**IPC:** C22C 9/00

**Language of the proceedings:** EN

**Title of invention:**

Copper alloy and method for its manufacture

**Applicant:**

Outokumpu Copper Products Oy

**Opponent:**

-

**Headword:**

-

**Relevant legal provisions:**

EPC Art. 56

**Keyword:**

"Inventive step (yes) - after amendment"

**Decisions cited:**

-

**Catchword:**

-



Case Number: T 0306/03 - 3.2.02

**D E C I S I O N**  
of the Technical Board of Appeal 3.2.02  
of 13 October 2005

**Appellant:**

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**Representative:**

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**Decision under appeal:**

**Decision of the Examining Division of the  
European Patent Office posted 25 October 2002  
refusing European application No. 97660095.7  
pursuant to Article 97(1) EPC.**

**Composition of the Board:**

**Chairman:** T. K. H. Kriner  
**Members:** R. Ries  
E. Dufrasne

## Summary of Facts and Submissions

I. This appeal is against the decision of the examining division dated 25 October 2002 to refuse European patent application No. 97 660 095.7.

The grounds of refusal were that the application did not meet the requirements of Articles 52(1), 54 and 56 EPC because the subject matter of claims 4 to 6 of the main request lacked novelty with regard to the disclosure of document

D1 Patent Abstracts of Japan, volume 004, No. 038, (C004), 27 March 1980, & JP 55 011145 A (Hitachi Cable Ltd., 25 January 1980)

and that the subject matter of method claims 1 to 3 of either the main and the auxiliary requests did not involve an inventive step having regard to the disclosure of documents D1 and

D3 West, E. G., "Copper and its Alloys", Ellis Horwood Ltd., John Wiley & Sons, 1982, pages 13, 35 to 37, 125, 126, 167, 168, 173 to 182.

II. On 21 December 2002 the appellant (applicant) lodged an appeal against the decision and the prescribed fee was paid on 18 December 2002. The statement of grounds of appeal was filed on 20 February 2003.

III. Enclosed with its response to the official communication setting out the Board's provisional view on the case and referring to document

D6 "Hochleitfähige Kupferlegierungen", Deutsches Kupferinstitut e.V. Berlin, 1958, pages 20 to 34

the appellant submitted a translation into English language of document D1.

At the end of the oral proceedings which took place on 13 October 2005, the appellant requested that

- the decision under appeal be set aside and
- a patent be granted on the basis of the main request or in the alternative, of the auxiliary request both filed during the oral proceedings.

IV. Claim 1 of the main request reads as follows:

"A method for the manufacture of heat exchangers comprising cooling fins made of a copper chromium alloy containing 0.1 to 0.3 % by weight chromium, rest copper and incidental impurities having a high recrystallization temperature and good conductivity, the method comprising the following steps:

- a) continuous strip casting,
- b) cold working by rolling,
- c) strand annealing,
- d) another cold working by rolling and
- e) brazing the heat exchangers at the temperature of more than 600°C whereafter the electrical conductivity of the cooling fins is at least 90% IACS."

Claim 1 of the auxiliary request reads:

"A method for the manufacture of heat exchangers comprising cooling fins made of a copper chromium alloy containing 0.2 % by weight chromium, rest copper and incidental impurities having a high recrystallization temperature and good conductivity, the method comprising the following steps:

- a) continuous strip casting **whereafter the electrical conductivity of the copper chromium alloy is 50 % IACS,**
- b) cold working by rolling,
- c) strand annealing,
- d) another cold working by rolling and
- e) brazing the heat exchangers at the temperature of more than 600°C whereafter the electrical conductivity of the cooling fins is at least 90% IACS."

V. The appellant argued as follows:

Document D1 related to a chromium-copper alloy comprising 0.01 to 0.5% Cr for producing heat exchanger pipes which were conventionally assembled by flame brazing. Heat exchanger fins were, however, brazed with a different brazing technique. Moreover, this document did not disclose the manufacturing steps for the production of fins stipulated by the claimed method. According to document D1, billets were prepared from a molten Cu-0.25% Cr alloy and subjected to hot forging, cold rolling and wire drawing.

By contrast, the claimed process provides for continuous strip casting followed by cold rolling, strand annealing, further cold rolling to the final thickness and brazing the heat exchanger fins. In

particular the continuous strip casting step represented the key feature of the invention. It resulted in a high quenching rate and, in consequence thereof, in an electrical conductivity of 50% IACS. This value indicated that after the continuous strip casting a huge part of the chromium was still maintained in solid solution. The further precipitation of this dissolved chromium took place in the following steps, so that after brazing at 600°C or more the high electric conductivity of 94% IACS aimed at for the fins was obtained. This object was not achieved by the prior art process known from document D1.

The documents D3 and D6 did not mention continuous strip casting either. Document D3 merely pointed to semi-continuous casting processes for (pure) copper to produce high quality round billets and/or rectangular section slabs for subsequent working. Moreover Properzi-casting of continuous lengths of cast rod is mentioned for immediate hot rolling and wire drawing. These casting methods were, however, far removed from the continuous strip casting technique required by the claimed method. Novelty and inventive step of the claimed method were therefore given.

## Reasons for the Decision

1. The appeal is admissible.

2. *Main request*

2.1 Amendments

Amended claim 1 originates from a combination of the technical features stipulated in claims 5 to 8 as originally filed and the technical disclosure given in the description, page 1, lines 5 and 6 and page 2, lines 16 to 20 of the application as filed. Dependent claims 2 and 3 correspond to claims 9 and 10 as originally filed.

Hence, there are no formal objections to the amended application documents with regard to Article 123(2) EPC.

2.2 Novelty and inventive step

2.2.1 Document D1 is considered as representing the closest prior art. Like the application, it discloses a heat resisting high conductivity copper alloy consisting of 0.01 to 0.5% Cr, 0.004 to 0.05% P, the balance being Cu which can be used i.e. for producing heat exchanger pipes rather than fins. Reference is made to example 1, Tables 1 and 2, disclosing a 0.035% P - 0.24% Cr - balance Cu alloy which exhibits an IACS of 93,4% after a 500°C/30 min heat treatment. As regards the production route, the molten Cu-0.24% Cr-0.035 %P alloy is cast into billets which are subjected to hot rolling, cold rolling and wire drawing followed by annealing at 500°C/30min (to simulate brazing) and further cold

working (tensile deformation 6%). The method of casting, (hot and) cold rolling, annealing and further cold working (either by rolling or wire drawing) as disclosed in D1 is therefore considered to represent the production route typically known in the art.

The claimed method differs from this prior art essentially by the steps of continuous strip casting, strand annealing, further cold rolling and brazing the fins at a temperature of more than 600°C. The claimed process is, therefore, novel with respect to that described in document D1.

- 2.2.2 Starting from this prior art, it has to be considered whether the distinguishing features are based on an inventive step.

As to the working steps, either (hot and) cold rolling to produce thin sheet material, e.g. for fins, or drawing rods into wire that is widened into pipes are generally selected by a skilled person in view of the final product aimed at. Therefore, these cold working steps are rated as representing equivalent technical measures which are applied by the skilled person without the exercise of any inventive activity.

As disclosed in document D3, continuous casting of (pure) copper (or of copper including very small amounts of Cr) into 250 mm wide rectangular slabs is generally applied and therefore is to be considered as a conventional casting method (cf. D3, page 168, first full paragraph). Although continuous strip casting is not explicitly mentioned in D3, the horizontal continuous casting process has been known in the art



for a long time as a means for producing relatively thin castings in long lengths that can be coiled in the cast state and later reduced by cold rolling. Moreover, "strand annealing" in its very general form is inappropriate to effect a distinction to the annealing treatment disclosed in document D1, and the brazing step is normally carried out at a temperature of more than 600°C, as set out on page 2, lines 16 and 17 of the application. Contrary to the appellant's position, the brazing process itself remains completely unspecified in the claim and therefore cannot give rise to a patentable difference to the brazing method given in document D1.

Hence, the process set out in claim 1 of the main request does not comprise technical features justifying an inventive step vis-à-vis the technical teaching disclosed in documents D1 and D3.

### 3. *Auxiliary request*

#### 3.1 Amendments

The wording of claim 1 of the auxiliary request corresponds to that of the main request except for the wording of

- (i) "0,2 % by weight chromium" and
- (ii) "**whereafter the electrical conductivity of the copper chromium alloy is 50 IACS**" added to step a).

These technical features have a basis in the application as originally filed, example 1, on page 3,

lines 15 to 17 and, therefore, satisfy the requirements of Article 123(2) EPC.

The description has been brought into strict alignment with the amended claims by deleting parts no longer encompassed by amended claim 1.

### 3.2 Problem and solution

As set out in document D1, an electrical conductivity higher than 90% IACS is obtained after a 500°C/30 min heat treatment which is chosen to simulate brazing after widening the wire into pipes. However, document D1 does not disclose that after a brazing at a temperature above 600°C such a high value is likewise achieved.

The problem to be solved by the application therefore resides in providing a process which reliably results in fins having an electrical conductivity of >90% IACS after brazing the thin cooling fins at a temperature of more than 600°C.

### 3.3 Inventive step

No compositional distinction is seen in feature (i) which essentially complies with the chromium content of 0.24% of the alloy No. 1 given in document D1, Table 1.

The Board, however, concurs with the appellant's position that an essential difference resides in feature (ii) requiring that after the continuous strip casting step the Cu-0.2%Cr sheet product exhibits an electrical conductivity of 50% IACS. This property

value indicates that only a part of the Cr dissolved in the melt has been precipitated during the continuous casting step and that a huge part of chromium is still kept in solid solution. The value also means a specific cooling rate that is to adhere to during the strip casting to monitor the precipitation of chromium. The provision of this continuous cast strip permits that in all the subsequent steps the precipitation of the remaining chromium in solid solution can be effected so that the electrical conductivity increases with each step as it is shown in the working example and in the single Figure of the application. In particular, it ensures the precipitation of all chromium during the final brazing step at a temperature of more than 600°C so that the object of the present application, i.e. an electrical conductivity of more than 90% IACS for the cooling fins after brazing, is successfully achieved.

The process disclosed in document D1 does not comprise any indications towards providing such a cooling regimen in the continuous casting step to produce thin Cu-Cr strip exhibiting an electrical conductivity of 50% IACS, and neither do the documents D3 and D6. None of these documents addresses the importance of the Cr-precipitation from solid solution during cold working, annealing and brazing to achieve a fine and evenly distribution of the Cr-precipitates. Hence the teaching of these documents could not assist a skilled person to achieve the object identified in the application. Given this situation, the process set out in claim 1 of the auxiliary request is not obvious to derive from the cited prior art and, therefore, involves an inventive step.

Dependent claims 2 and 3 relate to preferred embodiments of the process stipulated in claim 1 and likewise allowable.

## **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:
  - Claims 1 to 3 of the auxiliary request submitted on 13 October 2005;
  - Description, pages 1 to 5 submitted on 13 October 2005;
  - Figure 1 as originally filed.

The Registrar:

The Chairman:

V. Commare

T. K. H. Kriner