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 No.: T 0879/90 - 3.2.2

Application No.: 80 901 802.1

Publication No.: 0 036 006

Classification: C22C 9/04, F28F 21/08

Title of invention: Heat exchanger unit having tubes made solely from a copper-zinc-alloy

D E C I S I O N
of 6 July 1993

Applicant: -

Proprietor of the patent: Granges Metallverken Aktiebolag

Opponent: Wieland-Werke AG Metallwerke

Headword:

EPC: Art. 56

Keyword: "Inventive step (yes)" - "Appeal dismissed"

Headnote
Catchwords

Europäisches Patentamt | European Patent Office | Office européen des brevets

Beschwerdekammern | Boards of Appeal | Chambres de recours

Case Number: T 0879/90 - 3.2.2

D E C I S I O N
of the Technical Board of Appeal 3.2.2
of 6 July 1993

Appellant: (Opponent)
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Representative:

Respondent: (Proprietor of the patent)
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Decision under appeal: **Interlocutory decision of the Opposition Division of the European Patent Office dated 4 September 1990 concerning maintenance of European patent No. 0 036 006 in amended form.**

Composition of the Board:

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

Summary of Facts and Submissions

I. European patent No. 0 036 006 was granted with effect from 5 June 1985 on the basis of European patent application 80 901 802.1, filed as an international application on 29 September 1980.

II. An opposition was filed against the patent on the ground of lack of novelty and inventive step (Article 100(a) EPC).

Nine documents were cited during the opposition proceedings in this respect.

III. In its Interlocutory Decision dated 4 September 1990 the Opposition Division decided that the amended version of the patent, communicated to the parties pursuant to Rule 58(4) EPC on 12 February 1990, met the requirements of the EPC.

Claim 1 in this version reads as follows:

"1. A heat exchanger for an internal combustion engine said heat exchanger unit having tubes made solely from a copper-zinc alloy, characterised in that said copper-zinc alloy has a small proportion of phosphorus exhibiting corrosion resisting properties, the alloy comprising 25 to 30 per cent zinc by weight of the alloy, 0.005 to 0.04 per cent phosphorus by weight, the rest of the alloy being copper, the recrystallised grain size of the alloy being within the range of 2 μm to 10 μm inclusive."

The dependent Claims 2 and 3 refer to particular embodiments of the heat exchanger according to Claim 1.

IV. On 6 November 1990, the Appellant (Opponent) filed a reasoned appeal against this decision and paid the appeal fee on the same date.

V. In its Grounds of Appeal, the Appellant based its arguments on document:

(3) US-A-3 615 922,

cited during the opposition proceedings, and newly cited the documents:

(B1) DCA-Fachbuch "Kupfer-Zink-Legierungen (Messing und Sondermessing)" (1966), page 91;
(B2) DKI-Fachbuch "Messing (Eigenschaften, Verarbeitung, Verwendung)" (1956), pages 186 to 191; and
(B3) JP-A-54-4814, published on 13 January 1979, represented by its English abstract.

In its communication of 4 May 1993, the Board expressed its intention also to discuss:

DIN 1785, May 1985, pages 1 to 4,

during oral proceedings, held on 6 July 1993.

VI. The Appellant, although duly summoned, was not represented at the oral proceedings before the Board.

Its arguments, submitted with the Grounds of Appeal, can be summarised as follows:

A corrosion resistant Cu-Zn alloy comprising 5 to 35% Zn, up to 0.1% Cu, the rest of the alloy being Cu, and having a grain size of 5 to 25 um was disclosed in document (3). This brass alloy was used as a cladding material on a steel substrate, because it added its inherent properties such as wear resistance, colour, oxidation resistance, and tarnish resistance to the high strength and cold formability of the steel support. Since possible applications of this composite material were those of heat exchangers and automotive components, the measure to use the cladding material alone as material for radiators, which did not call for high strength, could not involve an inventive step. Moreover, it was generally known, as documented for instance by (B1), that lower grain sizes resulted in higher tensile strength values.

Brass had been the traditional material for radiator tubes (see (B2)) and document (B3) recommended to manufacture radiator tubes from a brass alloy comprising 20 to 40% Zn and inter alia 0.02 to 0.10% P.

VII. The Respondent, in its written submissions and during the oral proceedings, presented the following essential arguments:

The invention had to be seen in the light of the fact that the market of heat exchangers for internal combustion engines was highly competitive and called for the highest reliability of the product at the lowest price. Since zinc was less expensive than copper, α-brass with 35% zinc had traditionally been used to manufacture radiators for automobiles. The wall thickness of the tubes had to be chosen as thin as possible, but thick enough for not to fail by corrosion during the lifetime of the automobile.

Against this tradition the invention suggested to chose a more expensive alloy with a higher copper content and less zinc. Since the low grain size value of this alloy resulted in a so much higher resistance against pinhole corrosion, the wall of the tubes could be made thinner without loss in reliability. Therefore the higher costs of the alloy were compensated by a reduced material consumption and a reduced weight of the radiator.

Since none of the cited documents pointed into this direction, the presence of an inventive step could not be denied.

VII. The Appellant requests that the decision under appeal be set aside and that the patent be revoked in its entirety.

The Respondent requests that the appeal be dismissed.

Reasons for the Decision

1. The appeal is admissible.

2. *Amendments*

Claim 1 is based on the original Claim 4 together with page 3, second paragraph, of the original description. Claims 2 and 3 are based on original Claims 6 and 7.

Claim 1 is narrower in scope than the granted Claim 1, because it is restricted with respect to the use and the composition of the alloy.

The amended claims do, therefore, not contravene Article 123 EPC.

3. *Novelty*

None of the cited documents discloses a heat exchanger for an internal combustion engine made from a brass alloy having the **composition and grain size** as specified in Claim 1.

The subject-matter of Claim 1 is, therefore, novel.

4. *Closest State of the Art and Difference*

Of all the documents cited during the opposition and appeal proceedings, only document (B3) discloses a specific brass composition as material for a radiator, that is a heat exchanger for internal combustion engines.

The brass alloy disclosed there consists of 20 to 40% (by weight) zinc, 0.02 to 0.1% phosphorus, 0.005 to 0.05% iron, and 0.02 to 0.5% tin, the balance being copper and inevitable impurities.

The subject-matter of Claim 1 differs from this state of the art in that the brass consists only of zinc, phosphorus, and copper (and is free of iron or tin), and in that the material has a recrystallised grain size of 2 µm to 10 µm inclusive.

5. *Technical Problem*

It is a well-known fact that the automobile supply industry, of which radiator fabrication is a part, is a highly competitive field. Radiators are required not to fail during the life time of the automobile, and to be light of weight, economically to manufacture and of low price.

α-brass is a traditional material for the manufacture of radiators, because it is resistant against the corrosive attack of the cooling fluid and easy to be worked on (document (B2), pages 187 and 188).

Copper is more expensive than zinc as a raw material. It has not been refuted by the Appellant, that, therefore, not all the α-brass alloys had been considered for the fabrication of radiators which had generally been recommended, for instance by DIN 1785, as materials for condensers and heat exchangers, but only those with the highest zinc content with which the existence of a stable α-phase could still be warranted, say about 35 per cent by weight (EP-B-0 036 006, page 2, second paragraph).

Since a heat exchanger made of brass will corrode (by means of the so-called dezincifying corrosion) under the influence of the cooling fluid, there is a minimum practical thickness for the tube walls when the tubes are made of conventional brass and thus there is a minimum practical limit to the improvement of heat conductivity and the saving of material cost that can be effected by minimising the thickness of the tube walls (EP-B-0 036 006, page 2, lines 25 to 29). Consequently, there was a need for a material which permitted to reduce the wall thickness of the radiator tubes without simultaneously reducing their life time.

In order to meet this need, document (B3) suggests to modify the traditional α-brass by the addition of small but obviously critical amounts of phosphorus, iron, and tin.

The skilled metallurgical engineer will immediately recognise that the brass alloy suggested by document (B3) will only exhibit the required qualities when the small quantities of the additives are well dissolved or at least dispersed throughout the alloy. Since each of these constituents exhibits a different solubility in the matrix alloy, particular (and costly) procedural precautions have to be taken to guarantee the uniform distribution of each of these additives in the material. Although the material disclosed in document (B3) may allow to reduce the wall thickness of the radiator tubes, it may negatively compensate this advantage by the higher costs for its preparation.

Consequently, the technical problem which had resulted in the development of the material according to document (B3) has still persisted after the publication of this document.

6. *Solution*

The solution to this problem presented by Claim 1 consists in the combination of the following three measures:

- addition of 0.005 to 0.04 per cent phosphorus by weight,
- adjustment of the recrystallised grain size to lie within the range of 2 µm to 10 µm, and
- reduction of the zinc content to lie within the range of 25 to 30 per cent.

In particular, the resistance to pinhole corrosion is reduced by these measures. Although the cost of the raw material is increased by the higher content of copper, this cost is more than compensated by the quantity of material which is saved as a consequence of the reduced wall thickness.

7. *Inventive Step*

It is known from DIN 1785, point 2.6., that, to be usable for the fabrication of condensers and heat exchangers, the average grain size of the brass material must not exceed 50 µm. Moreover, DIN 1785 suggests the brass alloy of the type K-Ms 72, the composition of one of the two types of which overlaps with the composition indicated in Claim 1, as a prospective material for heat exchangers and condensers.

It is, however, generally known in this art that grain sizes which are below a certain limit require particular procedural precautions to be taken in order to warrant their complete recrystallisation. This fact is confirmed for instance by document (B1), which displays in its Figure 47 that the tensile strength of three brass alloys, one of which is Ms 72, increases with decreasing average grain size. The curves, however, do not consider grain sizes of lower than 15 µm.

Consequently, a skilled person does not interpret document (B2) to disclose that the brass K-Ms 72 should have a grain size within the range of 2 to 10 µm. Grain sizes higher than 15 µm, however, do not qualify this material for the manufacture of radiators in the meaning of the patent in suit.

Document (3) discloses a process to produce an integral composite metal article which has a suitable grain size for mechanical deformation. The composite article consists of steel support at least one side of which is clad with a brass alloy containing from 5 to 35% zinc and a grain-growth-inhibiting element selected from the group consisting of iron, cobalt, phosphorus, calcium, and mixtures thereof. If the grain growth inhibiting element is phosphorus, its content is up to 0.1%. The cladding (brass) alloy is intended to contribute to the composite the favourable appearance while retaining the bulk properties of the core material (column 1, lines 16 to 18,). This is confirmed by the statement that the development of the fine grain in the brass alloy mainly aims at avoiding the tendency to orange peel upon various working operations, thus ensuring a **high-quality surface pleasing in appearance** (column 2, lines 44 to 48). The desired properties of the cladding are wear resistance, colour, oxidation, conductivity, or tarnish resistance and fine finishing, i.e. **surface quality** (column 1, lines 23 to 26).

Since the particular problem of ablative or even pinhole corrosion, which are due to the particular phenomenon of dezincification by a cooling fluid, is not addressed in this document, the decorative brass clad side is obviously intended to face the normal atmosphere only, even in the case when the composite is used as a material for heat exchangers. Consequently, the Board cannot recognise any reason, why a skilled person looking for a remedy to the problem of dezincification arising with a radiator having tubes made solely from a copper-zinc alloy should expect to find a solution in a document which does not address this problem at all.

Following the above considerations, the documents (3), (B1), (B2), and (B3), even when considered in combination, cannot throw any doubt on the fact that the subject-matter of the independent Claim 1 involves an inventive step.

The Board, by its own motion, has also examined the further documents, which were cited during the opposition proceedings but were no longer relied upon by the Respondent during the appeal proceedings, and shares the opinion of the decision under appeal with respect to these documents.

The Board, therefore, comes to the conclusion that the subject-matter of Claim 1 cannot be derived in an obvious manner from the documents cited by the Appellant and must accordingly be seen as involving an inventive step within the meaning of Article 52(1) in combination with Article 56 EPC.

8. The independent Claim 1, together with the dependent Claims 2 and 3, as well as the description and figures which form the basis of the decision under appeal are, therefore, not objectionable in the light of the EPC.

Order

For these reasons, it is decided that:

The appeal is dismissed.

The Registrar: The Chairman:

S. Fabiani M. Aúz Castro