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D E C I S I O N
of 13 December 2005

Case Number: T 0594/03 - 3.2.02

Application Number: 96630018.8

Publication Number: 0799665

IPC: B23H 7/08

Language of the proceedings: EN

Title of invention:

Method of manufacturing a wire electrode for electro-discharge machining

Patentee:

SWIL LIMITED

Opponent:

Berkenhoff GmbH

Headword:

-

Relevant legal provisions:

EPC Art. 83, 56

Keyword:

"Sufficiency of disclosure (yes) "

"Inventive step (yes) "

Decisions cited:

-

Catchword:

-



Case Number: T 0594/03 - 3.2.02

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

Appellant: Berkenhoff GmbH
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Decision under appeal: Decision of the Opposition Division of the
European Patent Office posted 4 April 2003
rejecting the opposition filed against European
patent No. 0799665 pursuant to Article 102(2)
EPC.

Composition of the Board:

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

Summary of Facts and Submissions

- I. The mention of the grant of European patent No. 0 799 665 on the basis of European patent application No. 96 630 018.8 was published on 9 May 2001.
- II. The granted patent was opposed by the present appellant on the grounds that its subject matter was insufficiently disclosed for it to be carried out by a person skilled in the art (Articles 100(b) and 83 EPC) and lacked an inventive step (Articles 100(a) and 56 EPC).
- III. With its decision posted on 4 April 2003 the Opposition Division held that the reasons and arguments submitted by the opponent did not preclude the maintenance of the patent as granted and rejected the opposition.

Independent claim 1 as granted reads as follows:

"1. A process of manufacturing spark erosion electrode which comprises plating with zinc by galvanising, a core wire made of brass, and of diameter more than desired diameter of the final wire and thermal processing along with reduction of diameter of the core wire, characterised in that, said thermal processing comprises of the following steps:

- (a) putting coil(s) of the zinc plated wire in a bath pot; and heating the pot in a furnace with double vacuum atmosphere being maintained by creating vacuum in the bath pot and also in the furnace, to avoid oxidation on the surface of the wire, said heating being commenced at a temperature of 60 to 70 °C and raising the

temperature gradually to below the melting point of zinc e.g. up to 370°C to 395°C, through a prolonged period of more than 24 hours, the temperature of the furnace being increased gradually from said starting temperature of 60-70°C, to said final temperature of the bath e.g. between 370°C to 395°C, depending on (i) the required thickness of zinc to be absorbed within the brass of the core wire, and (ii) the diameter of the core wire, said final temperature being maintained for 18 to 20 hours;

(b) gradually cooling the bath pot upto the ambient temperature through a prolonged period of about 24 hours;

(c) pickling the coil(s) of wire, so heated and cooled, to remove slight coating of nitride, formed out of non-oxidising atmosphere during said heating/cooling;

(d) drawing the wire to reduce its diameter to an intermediate stage almost upto the desired final diameter thereof;

(e) gradually heating the so cooled coil(s) of the wire in double vacuum atmosphere through prolonged period of over 24 hours, as in step(a), and

(f) finally drawing the wire upto its desired diameter, followed by resistance annealing of said wire, by resistance heating arrangement, provided inbuilt with the drawing machine, where high current of electromotive force is caused to be passed through the wire at low voltage so as to heat the wire almost immediately due to the resistance of the wire".

The dependent claims 2 to 21 relate to preferred embodiments of the process set out in claim 1.

IV. The appellant (opponent) lodged an appeal, received at the EPO on 10 May 2003, against the decision of the Opposition Division. The appeal fee was paid simultaneously and the statement setting out the grounds of appeal was received at the EPO on 4 August 2003.

In the statement of grounds of appeal the following documents and pieces of evidence were referred to:

- OP5 calculation sheet for determining the diffusion time of Zn in α -brass
- OP6 H. Schumann: Metallographie, 12th edition, 1955, pages IV, 29
- OP6a W. Seith: Diffusion in Metallen, Münster 1955, pages 54, 55
- OP7 Lexikon Werkstofftechnik, VDI-Verlag, Düsseldorf, 1993, ISBN 3-18-401328-6, page 1165
- OP8 Dies: Kupfer und Kupferlegierungen, 1967, ISBN 3540-037594, pages 330 to 333
- OP9 FR-A-2 663 953

- D1 US-A-4 686 153
- D2 EP-A-0 334 971
- D4 US-A-5 196 665
- D5 EP-A-0 526 361

V. In reply to the statement of grounds of appeal, the patentee referred to

D9 R. E. Smallman: Modern Physical Metallurgy, 3rd edition, 1970, Butterworth, London, pages 128 to 135 (marked as attachment 1 by the patentee)

VI. To meet the request of the parties, oral proceedings took place on 13 December 2005.

The appellant requested that the decision under appeal be set aside and the patent be revoked in its entirety.

In a letter dated 29 September 2005, the respondent (patentee) informed the Board that he would not attend the oral proceedings. In accordance with the provisions of Rule 71(2) EPC the proceedings were continued without him.

The respondent requested in his written submissions that the appeal be dismissed.

VII. The arguments put forward by the appellant can be summarised as follows:

The calculations of the diffusion time at the given temperature level based on the theoretical data given in documents OP5, OP6, OP6a and on the Cu-Zn binary phase diagram OP7 showed that after about 9,6 h the Zn coating had completely vanished in the α -brass core and the diffusion came to an end. For a higher temperature level, the complete diffusion time was even shorter and no Zn-enriched zone existed on the surface. Moreover, the Zn coating was expected to volatilize when using a "double vacuum" diffusion treatment as was apparent from document OP8. This all went to show that the formation of a $\beta+\gamma$ phase outer surface layer on the α -brass core was impossible to achieve and that the

teaching given in the patent could not be put into practice by a skilled person. The requirements of Article 83 EPC were therefore not met.

Moreover, a diffusion heat treatment in an inert or oxidising atmosphere followed by a recrystallisation heat treatment for producing EDM wire electrodes having an outer surface layer of different CuZn-phases (α , β , β' , γ) was known from the documents D1, D2 and D5. The skilled person further knew from document OP9 that heat treating e.g. a steel wire in a "double vacuum furnace" promoted the formation of a "more homogeneous" microstructure in the wire. It was therefore obvious to apply the double vacuum diffusion heat treatment in the claimed process since this process likewise aimed at producing a uniform composition (see the patent specification, e.g. page 4, line 34). The claimed process was therefore not inventive with respect to the cited prior art.

VIII. In reply, the respondent argued substantially as follows:

The invention amply disclosed and claimed in the patent dealt with a very specialized diffusion process using the Kirkendall-effect. The process stipulated in claim 1 enabled creating an EDM wire having a thin surface structure enriched in zinc on a α -brass core as depicted in the microphotographs Figures 3 to 5 of the patent and as additionally shown on the microphotographs submitted by the patentee during the opposition proceedings. The micrographs clearly proved the existence of a Zn-rich outer surface layer comprising $\beta+\gamma$ CuZn-phase. The appellant's arguments and

theoretical considerations based on the mass equilibrium theory did not apply to the prolonged diffusion process claimed in the patent because the process was carried out below the melting point of Zn, preferably between 370 to 395°C, in a double vacuum and was strongly influenced by the Kirkendall effect. Having regard to the detailed description in the patent, there was no reason why a skilled person should not be able to carry out the claimed process.

None of the documents relied upon by the appellant, taken individually or in combination, taught a skilled person to arrive at the claimed process, i.e. to perform a controlled diffusion heat treatment of the Zn coated alpha brass core wire in a double vacuum atmosphere, as has been confirmed in the decision of the Opposition Division. The claimed process resulted in a wire electrode having a better splashability and a tensile strength higher than that of conventional EDM wire electrodes. The claimed process was therefore novel and involved an inventive step.

Reasons for the Decision

1. The appeal is admissible.
2. *Sufficiency of disclosure*
 - 2.1 In the appellant's view, the patent fails to disclose the claimed invention in a sufficiently straightforward manner for it to be carried out by a person skilled in the art. To confirm its position, the appellant submitted physical-chemical calculations to show that

the concentration profile for zinc and the metallographic structure of the Zn-coated alpha messing core wire could not be obtained by the long time diffusion process set out in claim 1. The practicability of the invention was further doubted with respect to the "double vacuum" heat treatment of the Zn-coated wire, in particular due to the high volatilization rate of Zn at a temperature close to or at the Zn-melting point in vacuum.

2.2 In its most general form the present invention is expressed by method claim 1 which defines all the steps of the claimed process. More specifically, claim 1 comprises the starting material, the diffusion heat treatment including the heating and cooling rates, the holding periods on a particular temperature level in a specific furnace atmosphere as well as the reduction rates when drawing the wire down to its intermediate and final diameter. Pursuant to Rule 27(1)e) EPC, the patent specification also describes a preferred embodiment of the invention (cf. the patent specification, paragraphs [0032] to [0041]) which comprises a detailed working example for practising the claimed process (see paragraphs [0042] to [0053] of the patent specification).

2.3 It is emphasized in this context that the subject matter stipulated in claims 1 to 21 is restricted to a process. It does not relate to a specific EDM wire electrode that is to be obtained by the process. Hence, the appellant's theoretical calculations and contentions based on documents OP5, OP6, OP6a, OP7, OP8 and concerning the microstructure of the final product that could or could not be obtained, i.e. the (complete

or incomplete) diffusion of the Zn-coating into the alpha brass core, have no bearing on the matter, all the more so since during the opposition proceedings the patentee has provided further evidence about the microstructure of the final EDM wire electrode. The evidence complies with the disclosure in the patent specification and shows that, due to the Kirkendall-effect (cf. document D9, in particular page 133), a definite structure rich in zinc only on the surface of the wire electrode can be successfully created by the claimed process so that the electrode performs better than conventional EDM wire (cf. also the patent specification, paragraphs [0050, 0051]. It further confirms the patentee's arguments that the diffusion heat treatment below the melting point of zinc does not run the risk of a high volatilisation of Zn, as alleged by the appellant with respect to document OP8.

2.4 The Board, therefore, concludes that the skilled reader is, in the present case, presented with adequate technical guidance and explanations, in particular those given in the description and the working example, to put into practice the claimed process, Hence, the requirements of Article 83 EPC are met.

3. *Novelty*

The novelty of the claimed process has not been disputed by the appellant. Having considered the available prior art, the Board sees no conceivable reason why it should deal with the issue of novelty any further.

4. *Inventive step*

At the oral proceedings, the appellant conceded the Board's view that document D5 represented the closest prior art. Like the patent at issue, this document aims at providing a less expensive process for producing electric discharge machining (EDM) electrodes having improved longevity and stability of the electric discharges which results in a better surface quality of the machined product (cf. D5, page 2, lines 48 to 55). The technical problem addressed by and the starting material (α -messing core wire coated with a Zn layer) used in document D5 are, therefore, the same as in the patent at issue. The process given in document D5 provides for a diffusion heat treatment above the melting point of zinc, i.e. between 400 to 455°C, preferably at 450±5°C, in an oxidising furnace atmosphere to promote the formation of a 30 to 100 µm thick homogeneous β' (beta prime) CuZn surface layer on the wire electrode (cf. D5, page 3, lines 34 to 42; page 4, lines 26 to 49; page 5, lines 30 to 37). Likewise, document D2 referred to by the appellant at the oral proceedings discloses a process for producing EDM electrode wire made of a CuZn alloy clad with a Zn coating which is after wire drawing transformed into a beta phase solid solution surface coating by a diffusion heat treatment in the range of 454 to 902°C in an oxidising atmosphere (cf. D2, column 1, line 44 to column 2, line 2; column 2, lines 36 to 44 claims 1 and 5).

The claimed process contrasts with this prior art process essentially by using a diffusion heat treatment (i) in a double vacuum at (ii) a temperature below the

melting point of Zn. A further distinction to the known process resides in the specific heating and cooling regimen that is to adhere to by the claimed process.

Document D1 referred to in the written statement of the grounds of appeal relates to copper clad steel wire coated with a zinc layer which is heated at about 380°C in air or a nitrogen atmosphere to convert the zinc layer into a CuZn alloy. However, much shorter holding times (1h, 7h) than those claimed in the patent are used, and this document is silent about the heating and cooling rates used in the diffusion heat treatment (cf. D1, column 2, lines 34 to 48; column 4, lines 3 to 6; column 5, lines 48 to 58; column 7, line 47 to column 8, first line; claim 3).

Document D4, on the other hand, discloses a method for producing a multi-layer EDM wire electrode which is drawn to cold form the electrode without causing any of the metals of the fine layers to diffuse into an adjacent layer. The diffusion of the different layers can be done directly on the EDM machine (cf. D4, claim 10; column 2, line 26 to column 3, line 31; column 5, lines 6 to 20).

The Boards have often stated that, to demonstrate lack of inventive step, there must have been a motivation for the man skilled in the art to adapt the prior art in a particular direction. Such motivation is absent here and has not been evidenced by the appellant having regard to the cited prior art. No information whatsoever could have been found anywhere in either documents D5 and D2 or any other document which could have occasioned the skilled person to perform a

diffusion heat treatment (i) in a double vacuum (ii) below the melting point of Zn and to apply a specific heating and cooling regimen, as does the process claimed in the patent, to produce an EDM wire which exhibits a better splashability and performs better than conventional EDM wire (cf. the patent specification, paragraph [0050]). This evaluation of the contents of the prior art has not been challenged by the appellant in the oral proceedings.

In consequence of the above made considerations, the process set out in claim 1 therefore involves an inventive step.

Order

For these reasons it is decided that:

The appeal is dismissed.

The Registrar:

The Chairman:

V. Commare

T. K. H. Kriner