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D E C I S I O N
of 6 May 1997

Case Number: T 0912/94 - 3.4.1

Application Number: 87112798.1

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Language of the proceedings: EN

Title of invention:
Electrode joint

Patentee:
Union Carbide Corporation

Opponent:
Pechiney, S.A., Paris

Headword:
-

Relevant legal provisions:
EPC Art. 56

Keyword:
"Inventive step of main, first and second auxiliary requests
(no) "

Decisions cited:
T 0037/82, T 0020/81

Catchword:
-



Case Number: T 0912/94 - 3.4.1

D E C I S I O N
of the Technical Board of Appeal 3.4.1
of 6 May 1997

Appellant: Union Carbide Corporation
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Representative: Gosdin
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Respondent: Pechiney, S.A., Paris
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Representative: -

Decision under appeal: Interlocutory decision of the Opposition Division
of the European Patent Office posted 11 October
1994 concerning maintenance of European patent
No. 0 260 529 in amended form.

Composition of the Board:

Chairman: H. J. Reich
Members: M. Lewenton
U. G. O. Himmler

Summary of Facts and Submissions

- I. The appellant is owner of European patent No. 0 260 529.
- II. This patent was opposed by the respondent on the grounds of lack of inventive step mentioned in Article 100(a) EPC citing *inter alia* the following documents:
- D1: FR-A-2 204 673;
- D2: G. Moutaud: "Influence de la vitesse de chauffage et des additifs minéraux et organiques sur le rendement des brais en coke", 1^{re} thèse, présentée à la Faculté des Sciences de l'Université de Paris et soutenue le 9 Mai 1961, deuxième partie, chapitre I à III, pages 27 to 53;
- D3: "Research and Development on Advanced Graphite Materials", Technical Report No. WADD TR 61-72, Volume XXXII, May 1964, pages 1 to 7; and
- D6: FR-A-1 141 464, corresponding to document
- D6': US-A-2 836 294, cited in the opposed patent.
- III. By an interlocutory decision within the meaning of Article 106(3) EPC the Opposition Division decided that the appellant's main, first and second auxiliary requests are not allowable under Articles 52(1) and 56 EPC and that the patent could be maintained in amended form on the basis of the appellant's third auxiliary request.

Claim 1 of the **main request** corresponds to Claim 1 as granted and reads as follows:

- "1. An electrode nipple for joining together two sections of an electric arc furnace electrode, said nipple having formed therein a reservoir communicating with a threaded portion on its surface and an electrically conductive, cementitious bonding material deposited in said reservoir for displacement to said threaded portion during use of said nipple, said cementitious bonding material comprising a major portion of pitch and a minor portion of a foaming agent, characterized in that said cementitious bonding composition contains from 2 to 15 percent by weight of **sulfur** as a foaming agent."

Claim 1 of the **first auxiliary request** filed with letter dated 9 February 1994 adds to the pre-characterising features of Claim 1 of the main request the features of granted Claim 3 reading "wherein said cementitious bonding material contains coal tar pitch particles having a softening point of from 75 to 200°C".

Claim 1 of the **second auxiliary request** filed with letter dated 9 February 1994, adds to the characterising part of Claim 1 of the first auxiliary request the features of granted Claim 6 reading "wherein said cementitious bonding material is contained inside a tube."

Claim 1 of the **third auxiliary request** filed on 15 September 1994 corresponds to granted Claim 2 and reads as follows:

"1. An electrode nipple for joining together two sections of an electric arc furnace electrode, said nipple having formed therein a reservoir communicating with a threaded portion on its surface and an electrically conductive, cementitious bonding material deposited in said reservoir for displacement to said threaded portion during use of said nipple, said cementitious bonding material comprising a major portion of pitch and a minor portion of a foaming agent, characterized in that said foaming agent is selected from the group consisting of **nitrated decant oil, 2,4-dinitroaniline** and mixtures thereof."

The further claims of each request are dependent on the respective Claim 1 and comprise an independent claim to:

"An electrode of an electric arc furnace, characterized in that said electrode comprises two electrode sections joined together by an electrode nipple as defined in one of" the preceding claims.

IV. In the interlocutory decision the Opposition Division took essentially the following view:

(a) **Main request:** By combining the corresponding teaching of documents D1 and D3 and by using his common technical knowledge, the skilled person would arrive at the subject-matter of Claim 1 without the need of any inventive step. The objective problem of decreasing the softening

point temperature of the bonding composition and of increasing the mechanical stability of the joint is solved by replacing pitch plus lignin sulfonate and water as used in D1 by pitch plus sulfur as disclosed in D3. Even if document D3 does not quote **expressis verbis** sulfur as a foaming agent, a skilled person **would** apply the teaching of D3, since this document states on page 5, paragraph 2 that pitch is rendered fluid by means of the sulfur at a temperature lower than e.g. 175°C, i.e. lower than the normal melting point of the pitch. The most effective percentage can be found in trial and error experiments.

- (b) **First and Second Auxiliary Requests:** The features introduced into Claim 1 of the first and second request lie within the bounds of normal design variations.
- (c) **Third Auxiliary Request:** Claim 1 of the third auxiliary request is allowable since the use of a foaming agent selected from the group consisting of nitrated decant oil, 2,4-dinitroaniline and mixtures thereof is neither suggested in the cited prior art nor obvious **per se**.

V. The patentee lodged an appeal against this interlocutory decision maintaining his requests as set out in paragraph III above, and **inter alia** argued that document

D1': US-A-4 007 324

would be the more relevant starting point for his invention than document D1 since it includes the further development of a "continuation".

In an answer to the grounds of appeal, the respondent **inter alia** supported his view, that the need for an improved bonding composition for a nipple joining together two sections of an electric arc furnace electrode, only arose after 1985 by the following evidence:

D7: EP-A-0 334 007,

D8: EP-A-0 309 583,

D9: MBM, December 1987,

D10: US-A-4 513 425, and

D11: "Metal Producing, January 1987.

VI. In preparing for oral proceedings the Board informed the parties of its provisional view, that having regard to the foaming of coal tar pitch by adding 0.5 to 20% sulfur as disclosed in document:

D2': US-A-3 353 978

cited in the European Patent Report, and the increase of the coking value from 20% (D1', column 4, line 18) to about 50% as disclosed in document D2, Figure 11 for pitch with 15% sulfur, Claims 1 of the main and first auxiliary requests may be regarded as obvious. Table 1 and Figure 5 to 7 of the patent under appeal evidence advantages of the invention with regard to pitch without any additive. There is no evidence on file of advantages with regard to the closest prior art, i.e. the cementitious bonding composition disclosed in

document D1', concerning pitch with lignin sulfonate plus wood sugar as a foaming agent; see D1', column 3, lines 46 to 65 and column 4, lines 13 to 17. The additional features of Claim 1 of the second auxiliary request would be obvious in view of document D6'.

VII. Oral proceedings before the Board were held on 6 May 1997. During the oral proceedings the appellant (patentee) requested that the decision under appeal be set aside and that the patent be maintained

- (a) as main request as granted;
- (b) as first and second auxiliary requests on the basis of the corresponding claims filed with letter of 9 February 1994,

The respondent (opponent) requested that the appeal be dismissed.

VIII. In support of his requests, the appellant made essentially the following submissions:

- (a) The cementitious bonding material disclosed in document D1' uses as foaming agent lignin sulfate and water. Since basically pitch is driven into the clearances within the tread by water vapour, the use of the known foaming agent results in an incomplete filling of the clearance between nipple and electrode sockets, so that a large part of the two opposite surfaces within the clearance of the joint remains uncovered by the bonding material. Furthermore, the addition of lignin sulfate has no effect on the coking value of the pitch. For both reasons, the use of the bonding material disclosed in document D1 results in a mechanically weak bond. Therefore, the objective problem underlying the present invention consists in increasing the

resistance of the joint between nipple and electrode against unscrewing, to decrease the time required to implement this resistance and to minimize the concentration of mechanical stress on the nipple and the socket threads; see also the patent under appeal, page 3, lines 1 to 9.

- (b) The invention solves this problem by a bonding material comprising pitch and 2 to 15% by weight of sulfur as a foaming agent. As disclosed in the original description, page 14, paragraph 1 sulfur melts, reacts with the pitch already at 150°C and provides for a high pressure which forces the melted pitch from the reservoir deep into the void space, so that it is filled out more completely and enlarges the contact area of the bond between nipple and electrode sockets with regard to the prior art disclosed in document D1'.
- (c) A skilled person would not consider the teaching of document D2', since it concerns the different technical field of building insulation, wherein the pitch is driven into large spaces between walls. Such use does not hint to use sulfur as foaming agent in order to drive pitch into the very fine clearances of a thread. Document D2 only discloses details of the coking process of a pitch-sulfur system and is silent about the higher driving power of sulfur with regard to lignin sulfonate and water. This advantage is not derivable from the simple statement in document D2 page 39, paragraph 1 that at 180°C foam is formed in abundance (mousse abondante). Document D3 does not teach to technically use the H₂S gas formed at

200°C as a foaming agent and enlists on page 6 a multitude of disadvantages which would dissuade a skilled person from a use of a pitch-sulfur binder in the joint between nipple and electrode sockets of document D1'.

- (d) Document D1' was published in 1977, document D2 in 1961, document D2' in 1967 and document D3 in 1964. The relative long period until the priority of the patent under appeal in 1986 is a strong indication of inventive step. Hence, only as a resultant of an inadmissible hindsight analysis, the three steps-omitting water, substituting lignin sulfonate by sulfur and using 2 to 15 percent by weight of sulfur - can be regarded as obvious.

IX. The above submissions were contested by the respondent, who argued essentially as follows:

- (a) The mechanism of driving pitch into the voids within the thread between a nipple and the sockets of an electric arc furnace electrode by a foaming agent is well known from document D1'. The skilled person knows that, for improving the result of the binding, he has to enlarge the coking value of pitch. Document D2 teaches not only on page 39, paragraph 1 that sulfur works as an extremely efficient foaming agent in pitch, but also, in Figures 10 and 11 that the addition of sulfur to pitch increases the coking value and therewith the mechanical strength of the binding.
- (b) Nothing inventive can be seen in the claimed region of the sulfur content from 2 to 15 percent by weight, since document D2 discloses on page 40,

paragraph 1 that already 1% of sulfur is sufficient to increase the yield of coke and that from 15 to 20% the yield does not increase further.

- (c) A further technically decisive advantage in the use of a pitch-sulfur system as bonding material is disclosed in document D3, pages 5 and 6. In particular on page 6, lines 9 and 10 it is stated that the pitch sulfur system has the advantage of becoming thermally set at 325°C as compared to 500°C for pitch alone. Such reduction of the coking temperature allows for decreasing considerably the time required for stabilising the bond. The disadvantages disclosed in D3, page 6, lines 12 to 20 are clearly meaningless in a use in the claimed joint, since the voids of the thread do not communicate with the volume outside the electrode.

- (d) As evidenced by documents D7 to D12, about 1985 a technical development of electrodes for arc furnaces considerably increased their standing time. Via oxidation resistant surface coatings or cooling systems the consumption of graphite in the contact region of the electrode with the liquid metal was reduced. The temperature gradient along the electrode changed and in the region of the joint the necessary temperatures for its hardening were not reached before mechanical stresses unscrewed the joint and made it unstable. Hence, only a short time before the priority date of the patent under appeal the technical need came up to look for more satisfying bonding materials.

- (e) A skilled person is aware of the development in neighbouring fields, such as the industrial use of a pitch-sulfur system in the sealing of buildings.

Furthermore, it is not inventive to test the existing bonding materials which are available and to select the best one.

- X. At the conclusion of the oral proceedings, the decision was announced that the appeal is dismissed and consequently the patent is to be maintained on the basis of the documents specified in Form 2339.4 annexed to the appealed interlocutory decision dated 11 October 1994.

Reasons for the Decision

1. It was not contested by the parties that the features defined by the wording of the pre-characterising parts of Claims 1 of the main and first and second auxiliary requests are disclosed in document D1'.
- 1.1 Document D1' discloses in the wording of the pre-characterising portion of Claim 1 of the main request:

"An electrode nipple (see D1', 10) for joining together two sections (11, 12) of an electric arc furnace electrode (column 1, lines 14 and 15), said nipple having formed therein a reservoir (13) communicating with a threaded portion on its surface (see the figure) and an electrically conductive, cementitious bonding material deposited in said reservoir (column 3, lines 35 to 37) for displacement to said threaded portion during use of said nipple (column 3, lines 37 to 42) said cementitious bonding material comprising a

major portion of pitch (100 parts by weight, see column 5, lines 50 to 52) and a minor portion (25 parts by weight; see column 5, lines 52 to 60) of a foaming agent (column 4, lines 13 to 17; column 5, lines 4 to 9).

1.2 Furthermore, document D1' discloses in the wording of the additional feature in the pre-characterising parts of Claims 1 of the first and second auxiliary request that "said cementitious bonding material contains coal tar pitch particles having a softening point of from 75 to 200°C (see D1', column 3, lines 43 to 56)".

2. Starting from the closest prior art disclosed in document D1' the objective problem underlying Claims 1 of the main and first and second auxiliary requests is:

(a) to increase the resistance of the joint between the two electrode sections and the electrode nipple against mechanical forces during use in an electric arc furnace in order to avoid unscrewing of the nipple; and

(b) to shorten the time needed for the implementation of such resistance, see the patent under appeal, page 3, lines 1 to 7.

Contrary to the appellant's view in paragraph VIII-(a), the further disclosed technical aim of minimising the concentration of mechanical stresses on the nipple and socket threads, cannot form part of the objective problem, since no evidence is on file that the pitch-sulfur system provides a "more uniform pitch distribution" than the pitch-lignin sulfonate-water system of the closest prior art.

However, the necessity to improve the above properties of the joint disclosed in document D1 arises in its practical use. Hence, the formulation of the objective problem cannot be regarded to contribute to an inventive step underlying Claims 1 of the above three requests.

3. *Inventive step-Claim 1-Main and First Auxiliary Request*

3.1 The objective problem set out in paragraph 2 above is solved according to Claims 1 of the main and first auxiliary requests in said:

"said cementitious bonding composition contains from 2 to 15 percent by weight of sulfur as a foaming agent."

3.2 The fact that sulfur works in an admixture to pitch as a foaming agent is disclosed in document D2, page 39, paragraph 1. It forms thus a known alternative to lignin sulfonate used in the closest prior art. Contrary to the appellant's argument in paragraph VIII-(d) the claimed range of an appropriate concentration of sulfur in pitch is disclosed in document D2, page 40, paragraph 1, see also paragraph IX-(b) above. Hence, the technical means of the solution claimed are disclosed in document D2 and a skilled person **could** have made use of them in the electrode nipple disclosed in document D1'.

3.3 A skilled person derives from document D1', column 2, lines 59 to 68 and column 4, lines 17 to 21 that the mechanical resistance of the joint is effected by the transformation of the bonding material into carbon as an effect of coking. It is thus obvious to a skilled person that the resulting mechanical resistance is proportional to the coking value of the bonding material. In the Board's view, the skilled person can

reasonably be expected to find out that for solving the objective problem set out in paragraph 2(a) above, he has to improve the coking value of bonding material. The bonding material used in the closest prior art reaches a coking value of 20%, see document D1', column 4, line 18. The skilled person derives from Figure 11 of document D2 that a pitch-sulfur system allows to increase the coking value of such bonding material; for instance at the claimed upper limit of 15% sulfur the resulting coking value increases up to 50%. Therefore, in the Board's view, the skilled person will expect an improved mechanical resistance of the joint. He thus has a clear technical motive and would replace the foaming agent used in the nipple of document D1' (lignin sulfonate) by the alternative disclosed in document D2 (sulfur).

3.4 Having regard to the solution of the objective problem set out in paragraph 2(b) above, the skilled person derives from document D2, page 40, paragraph 1 that the coking values in Figure 11 are all measured after coking for 5 to 6 hours at 200°C, and from Figure 10 that at 10% sulfur and 200°C a coking value of 50% can already be reached after 2 hours. Therefore, in the Board's view, it is obvious to a skilled person that the use of sulfur in pitch automatically allows for a quick implementation of the mechanical resistance against unscrewing. In view of the low maximum coking value of 20% in document D1' the skilled person can be regarded to foresee that the replacement of lignin sulfonate by sulfur also shortens the time for implementing a necessary mechanical strength of the bond between nipple and electrode sockets.

3.5 The original description of the patent under appeal, page 14, paragraph 1, last sentence reads: "This gas pressure buildup in turn forces the melted pitch even

deeper into the threaded engagement so as to fill more void spaces between the threads and to contact a greater number of the threads than was heretofore possible using **pitch without the foaming agent**". The advantages submitted by the appellant in paragraph VIII-(b) are thus disclosed to be effected by the use of a foaming agent. Since the closest prior art uses as well a foaming agent, they may well be achieved already in the technical starting point of the present invention in an equivalent way. There is no evidence on file in form of a comparative example that the use of sulfur in pitch develops at the same temperature a higher drive-in pressure and produces a more complete filling of the void spaces within the thread than lignin sulfonate. Hence, these submitted advantages cannot be regarded as relevant in an examination of inventive step, because they have to be classified as an allegation. It represents a well established legal practice of the Boards of Appeal of the EPO that in order to render alleged advantages relevant to the definition of the objective problem underlying an invention and thus to the assessment of inventive step, they have to be supported by sufficient evidence where comparison is made with the closest prior art, see also decision T 20/81, OJ EPO 1982, 217.

- 3.6 The fact that documents D1' and D2 have been known for a long time (see paragraph VIII-(d)) cannot be regarded as indicative of inventive step, since the need for a more effective cementitious bonding material in joints of an electric arc furnace electrode in the Board's view only arose shortly before the priority date of the invention, see paragraph IX-(d).
- 3.7 The Board regards a skilled person as able to realise that the disadvantages of a use of sulphur as foaming agent in pitch disclosed in document D3, page 6,

lines 12 to 20 - such as the poisonous properties of the developing H₂S gas, its corrosive effect to steels and its contribution to the oxidation of graphite - would have no technical effect within the closed system of reservoir and thread inside the electrode, see paragraphs VIII-(c) and IX-(c)

- 3.8 For the reasons indicated in detail in paragraphs 2 and 3.1 to 3.7 above, in the Board's judgment Claims 1 of the main and first auxiliary request lack an inventive step within the meaning of Article 56 EPC.

4. *Inventive step-Claim 1 Second Auxiliary Request*

The additional feature comprised in the characterising part of Claim 1 of the second auxiliary request reads:

"said cementitious bonding material is contained inside a tube."

It is nowhere disclosed in the original description of the patent under appeal that the above feature contributes to the solution of the objective problem set out in paragraph 2 above. Such features can normally be disregarded in an assessment of inventive step, see also T 37/82, OJ EPO 1984, 71. Moreover, a tube containing the bonding material for nipple and sockets of an electric furnace electrode is disclosed in document D6'; see D6', 16 in Figure 4. Making analogous use of such tube in the nipple disclosed in document D1' is obvious. Hence, in view of the above, Claim 1 of the second auxiliary request is held to lack an inventive step within the meaning of Article 56 EPC.

5. All cleams directed to an electrode nipple in the main, first and second auxiliary requests fall because of their dependence on the respective Claim 1. The respective further independent claim of all three

requests is directed to an electrode and falls as well, because this electrode is exclusively characterised by being joined by the non-inventive electrode nipple according to one of the preceding claims.

Order

For these reasons it is decided that:

1. The appeal is dismissed.
2. Consequently, the patent is to be maintained on the basis of the documents specified in Form 2339.4 annexed to the appealed interlocutory decision dated 11 October 1994.

The Registrar:

The Chairman:

M. Beer

H. J. Reich