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D E C I S I O N
of 8 January 1998

Case Number: T 0414/95 - 3.2.1

Application Number: 86303147.2

Publication Number: 0200499

IPC: B23K 9/06

Language of the proceedings: EN

Title of invention:
Method of igniting arcs

Patentee:
Nippon Steel Corporation

Opponent:
Robert Bosch GmbH

Headword:
-

Relevant legal provisions:
EPC Art. 56

Keyword:
"Inventive step (yes)"

Decisions cited:
-

Catchword:
-



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Boards of Appeal

Chambres de recours

Case Number: T 0414/95 - 3.2.1

D E C I S I O N
of the Technical Board of Appeal 3.2.1
of 8 January 1998

Appellant: Robert Bosch GmbH
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Representative: -

Respondent: Nippon Steel Corporation
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Decision under appeal: Interlocutory decision of the Opposition Division
of the European Patent Office posted 1 March 1995
concerning maintenance of European patent
No. 0 200 499 in amended form.

Composition of the Board:

Chairman: F. Gumbel
Members: S. Crane
J.-C. Saisset

Summary of Facts and Submissions

I. European patent No. 0 200 499 was granted on 22 January 1992 on the basis of European patent No. 86 303 147.2

II. The granted patent was opposed by the present appellants on the grounds that its subject-matter lacked inventive step (Articles 100(a) and 56 EPC).

Of the prior art documents relied upon in the opposition proceedings only the following played any role on appeal:

(D3) DE-A-2 046 235.

III. With its interlocutory decision posted on 1 March 1995 the opposition held that the patent could be maintained in amended form (Article 102(3) EPC).

IV. An appeal against this decision was filed on 29 April 1995 and the fee for appeal paid at the same time.

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

The statement of grounds of appeal was filed on 21 June 1995. In this statement the appellants referred to two further prior art documents, viz.

(D4) CH-A-573 788,

(D5) DE-B-2 161 896.

V. Oral proceedings before the Board were held on 8 January 1998.

At the oral proceedings the respondents (proprietors of the patent) submitted new sets of claims according to a main and an auxiliary request and requested maintenance of the patent in amended form on the basis of these claims together with an amended description also submitted at the oral proceedings and the drawings as granted.

Claim 1 according to the main request reads as follows:

"1. A method of igniting an arc without applying a high frequency voltage between an electrode (2) and a workpiece (3), the method comprising the steps of:

arranging at least one electrode (2) and the electric tip of the electrode (2) so as to face the workpiece (3) on which an operation is to be performed,

arranging an auxiliary electrode (13) so as to face the side surface of the electrode (2) or the side surface of the electrode tip,

connecting the electrode (2) with its electrode tip to the negative terminal of a D.C. power source for performing the operation on the workpiece (3), the workpiece (3) being connected to the positive terminal of the D.C. power source,

grounding both the auxiliary electrode (13) and the workpiece (3) so as to direct the electric field from the auxiliary electrode (13) towards the electrode (2) or the electrode tip,

projecting an ignition-plasma into the electric field from the vicinity of the auxiliary electrode (13) against the electrode (2) or the electrode tip to form a cathode spot on the electrode (2) or the electrode tip, and

first forming an arc between the electrode (2) or the electrode tip and the auxiliary electrode (13) and then transferring the cathode spot to the forward end of the electrode (2) by making use of the flow rate of shield gas and the shape of the electric field, defining the shape of the electric field by using a geometrical arrangement of the workpiece (3), electrode (2) and auxiliary electrode (13) so that the arc formed between the electrode (2) and the auxiliary electrode (13) is transferred so that it is formed between the electrode (2) and the workpiece (3)."

Claim 2 relates to a preferred embodiment of the method according to claim 1.

Claim 1 according to the auxiliary request has been restricted to the arrangement in which the auxiliary electrode faces the side surface of the electrode, thus eliminating the alternative where the auxiliary electrode faces the side surface of the electrode tip.

VI. The arguments put forward by the appellants in support of their request can be summarised as follows:

The basic principle of operation of the arc igniting method disclosed in document D3, which represented the closest state of the art, was very similar to that of the claimed invention. In particular, there was provided a plasma generator which injected plasma between the electrode and an auxiliary electrode and an arc was formed between the electrode and the auxiliary electrode, as could be seen from claim 4 and paragraph 4, page 3 of the description. Although document D3 did not explicitly disclose the way this arc would move under the influence of the electric field and the flow of the shield gas, as set out in the claims under consideration, it was nevertheless inherent in the construction shown in the prior art

that this movement would occur. Furthermore, the requirement in these claims that the workpiece and the auxiliary electrode be grounded, which was also not explicitly disclosed in document D3, was a trivial measure which the person skilled in the art would adopt on the basis of routine safety considerations.

Thus the only significant difference between the method claimed and that disclosed in document D3 was the requirement that the arc be ignited without applying a high-frequency voltage between the electrode and the workpiece. It was however well-known, as evidenced by documents D4 and D5, that the application of a high-frequency voltage between an electrode and a workpiece to ignite an arc could be dispensed with once an auxiliary arc had been established between an auxiliary electrode and the workpiece (document D4) or between an auxiliary electrode and the electrode (document D5). Having regard to that it would not have involved an inventive step to dispense with the high-frequency voltage proposed in document D3 for igniting the main arc in order to solve the problems associated with this voltage interfering with electronic control equipment.

VII. In reply, the respondents argued substantially as follows:

According to the claimed invention a well defined sequence of events occurred on ignition of the arc between the electrode and the workpiece. None of this, apart from the initial injection of plasma, was mentioned in document D3 and to pretend that the required sequence of events was inherent to the structure disclosed there was wishful thinking on the part of the appellants. Although document D3 did include an obscure reference to the completion of a plasma arc to the electrode as an additional measure to improve ignition of the main arc, this was not

exemplified in any way, and one thing remained clear, namely that the application of a high-frequency voltage for igniting the main arc was necessary. It was that very measure which the claimed invention set out to eliminate. All that the new documents D4 and D5 showed in this respect was that it was possible to dispense with the application of a high-frequency voltage for igniting a main arc once an auxiliary arc was established and left ignited during the time the main arc was in operation. There was nothing in these documents which could lead the person skilled in the art to the claimed invention.

Reasons for the Decision

1. The appeal complies with the formal requirements of Articles 106 to 108 and Rules 1(1) and 64 EPC. It is therefore admissible.
2. *Admissibility of the amended documents (main request)*

Present claim 1 has been derived from granted claim 1 by the incorporation of the requirement that no high-frequency voltage is applied between the electrode and the workpiece, this having been indicated in the original application as being the prime objective of the invention, and by defining more fully how the arc originally formed between the electrode and the auxiliary electrode is transferred so that it subsequently forms between the electrode and the workpiece. An equivalent explanation is to be found with respect to the original Figures 5, 6a and 6b.

Dependent claim 2 corresponds to granted claim 2.

The description has been revised to bring it into line with the amended claim 1.

Thus there are no objections under Articles 123(2) and (3) EPC to the amended documents.

3. *Technological background; the claimed invention*

As explained in the introductory description of the patent specification, it was well-known to ignite a DC arc between an electrode and a workpiece by impressing a large high-frequency voltage between them to induce dielectric breakdown. However, according to the patent specification, the level of the high-frequency voltage is such that electromagnetic noise of a substantial magnitude is produced with the consequence that electronic control devices or measuring equipment incorporated for example into an automatic welding machine might suffer damage or operate unreliably. It is therefore the object of the invention to provide a method of igniting an arc between an electrode and a workpiece without substantially producing high-frequency noise of high magnitude.

According to the claimed invention this is achieved in essentially the following way:

Initially, an arc is formed between the electrode and an auxiliary electrode by projecting ignition plasma into the space between them. The electrode is connected to the negative terminal of a DC power source and the auxiliary electrode and the workpiece are both grounded. Under the influence of the flow of a shield gas and the shape of the electric field the cathode spot on the electrode then moves towards the forward end of the electrode with consequential distortion of the arc until a point is reached where the anode spot will be transferred automatically from the auxiliary electrode to the workpiece, thus igniting the required arc between the electrode and the latter.

Although in one embodiment a high-frequency voltage is used to ignite the arc in the plasma generator, its level can be restricted to a value at which no detrimental interference effects with electronic control devices are observed.

4. *Novelty and inventive step (main request)*

It is not in dispute that the subject-matter of claim 1 is novel. It is similarly common ground between the parties that document D3 represents the closest state of the art. What is in dispute is what that document actually discloses, explicitly and implicitly.

According to claim 1 of document D3 it is proposed to ignite a welding arc between a gas shielded non-consumable welding electrode and a workpiece by means of a non-completed plasma arc ("mittel eines nichtübertragenen Plasmalichtbogens"). As described with reference to the single preferred embodiment a plasma generator is located at the side of the electrode and is preferably arranged to project a jet of plasma towards the tip of the electrode to ionize the gas in this region and thus promote ignition of the welding arc, see the paragraph bridging pages 2 and 3 and the first full paragraph of page 3. An auxiliary arc in the plasma generator is ignited by means of a high-frequency voltage generator. A second high-frequency voltage generator is also provided for igniting the welding arc, see the paragraph bridging pages 7 and 8 and the second full paragraph of page 8.

According to claim 4 of document D3 and the equivalent passage of the description in the third full paragraph of page 3, ignition reliability can be further improved when the welding arc is additionally ignited by means of a plasma arc completed to the welding electrode ("mittels eines auf die Schweißelektrode übertragenen

Plasmalichtbogens"). It is stated in the first full paragraph of page 4 that when an additional completed plasma arc is used then both plasma arcs should carry a current of at most 2.5 amps. No further information is given as to how this completed plasma arc is to be generated or as to how it behaves before the welding arc is ignited. The appellants have sought to argue that the reference to an "additional" completed plasma arc in claim 4 is a terminological inexactitude and that what the author of document D3 really intended to say was that preferably the plasma arc referred to in claim 1 was "completed", in other words that a current carrying arc was struck via the injected plasma between the welding electrode as cathode and the nozzle of the plasma generator as anode. That interpretation is however at odds not only with the plain wording of claims 1 and 4 but also with the passage on page 4 quoted above which clearly refers to two distinct plasma arcs. Nevertheless, it is a fact that document D3, although the information given in this respect is sparse, does propose the use of a completed plasma arc for promoting the ignition of the welding arc and that the person skilled in the art, on the basis of his common general knowledge, would understand that in all probability this completed plasma arc is maintained between the welding electrode and an anode constituted in a manner corresponding in general terms to that disclosed in the contested patent - by the nozzle of a not further disclosed plasma generator. On the other hand, the document contains no suggestion that the completed plasma arc behaves in the manner required by present claim 1 so that under the influence of the flow of shield gas and the shape of the electric field it is automatically transferred to form between the welding electrode and the workpiece thus igniting the welding arc. Furthermore, it is clearly not the case that this behaviour of the completed plasma arc is inherent to the structure disclosed in document D3, as

argued by the appellants, since if it were then there would be no need for the application of a high-frequency voltage, as proposed in the document, for igniting the welding arc. Lastly, the Board cannot accept the alternative argument developed by the appellants that the "transfer" of the arc envisioned by present claim 1 was a play on words and could be equated to the situation disclosed in document D3 wherein once favourable conditions have been established by means of the completed plasma arc the welding arc was ignited and the plasma arc extinguished. It is the opinion of the Board that present claim 1, particularly when read in the light of the description, in no way involves a play on words but instead clearly requires that the arc between the electrode and the workpiece is ignited as a direct consequence of the defined behaviour of the arc initially formed between the electrode and the auxiliary electrode and that this behaviour can be fairly said to involve a "transfer" of the arc as opposed to the ignition of one arc and extinction of the other.

As a consequence of the above it is apparent that the subject-matter of present claim 1 is significantly distinguished from the disclosure of document D3 not only, as argued by the appellants, by the fact that according to the claimed invention no high-frequency voltage is applied between the electrode and the workpiece to ignite the arc between them, but also by the features set out in the claim defining the behaviour of the arc initially formed between the electrode and the auxiliary electrode, it being that behaviour that enables the high-frequency voltage to be dispensed with. There is nothing in the cited state of the art from which the person skilled in the art can derive an equivalent teaching. Documents D4 and D5 have been relied upon by the appellants in this respect but

all that can be seen from these documents, in general terms, is that it was known that with the assistance of an auxiliary arc an arc could be ignited between a main electrode and a workpiece without the application therebetween of a high-frequency voltage. According to document D4 the auxiliary plasma arc is maintained permanently between a non-consumable auxiliary electrode and the workpiece and surrounds the welding arc between a consumable electrode and the workpiece with the purpose of providing additional heating to the workpiece. The auxiliary arc is ignited by means of the application of a high-frequency voltage between the auxiliary electrode and the workpiece. In document D5, on the other hand, the auxiliary arc, ignited by means of a high-frequency voltage, is maintained permanently between an auxiliary electrode and the electrode. There is no suggestion of any movement or transfer of this auxiliary arc so that it forms between the electrode and the workpiece.

Accordingly the Board has come to the conclusion that the subject-matter of claim 1 of the main request involves an inventive step (Article 56 EPC) and that this claim together with its dependent claim 2 and the revised description form a suitable basis for maintenance of the patent in amended form.

Order

For these reasons it is decided that:

1. The decision under appeal is set aside.

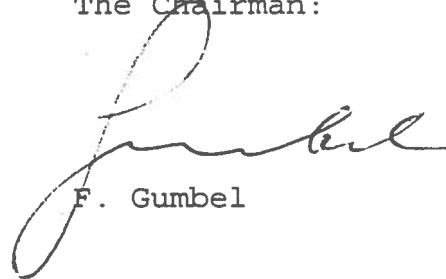
2. The case is remitted to the first instance with the order to maintain the patent in amended form on the basis of claims 1 and 2 of the main request and the adapted description both submitted at the oral proceedings together with the drawings as granted.

The Registrar:



S. Fabiani

The Chairman:



F. Gumbel

