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Bezeichnung der Erfindung:
Title of invention:
Titre de l'invention : Automatic weld line following method

Klassifikation / Classification / Classement : B23K 9/02

ENTSCHEIDUNG / DECISION

vom / of / du 16 November 1990

Anmelder / Applicant / Demandeur :

Patentinhaber / Proprietor of the patent /
Titulaire du brevet : Mitsubishi Jukogyo Kabushiki Kaisha

Einsprechender / Opponent / Opposant : Siemens Aktiengesellschaft

Stichwort / Headword / Référence :

EPÜ / EPC / CBE Art. 56

Schlagwort / Keyword / Mot clé : "Inventive step (yes)"

Leitsatz / Headnote / Sommaire

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Case Number : T 77/89 - 3.2.4

D E C I S I O N
of the Technical Board of Appeal 3.2.4
of 16 November 1990

Appellant : (Opponent)
Siemens Aktiengesellschaft
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Representative :

Respondent : (Proprietor of the patent)
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Representative :
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Decision under appeal :
Decision of Opposition Division of the European Patent Office dated 20 October 1988 and dispatched on 28 November 1988 rejecting the opposition filed against European patent No. 0 111 110 pursuant to Article 102(2) EPC.

Composition of the Board :

Chairman : C. Andries
Members : H. Seidenschwarz
M. Schar

Summary of Facts and Submissions

I. European patent No. 111 110 concerning an "automatic weld line following method" and comprising a single Claim was granted on 21 January 1987 in response to European patent application No. 83 110 349.4 filed on 17 October 1983.

II. The Claim as granted reads as follows:

"An arc welding method of welding a work (12) having a joint by feeding a consumable electrode (6) toward a weld line formed in said joint through the tip (3) of a welding torch (1) and by oscillating said welding torch (1), said method for automatically following said weld line comprising the steps of:

detecting a welding current, and

controlling the position of said torch (1) at all times so that the positional relationship between said oscillation center and the center of said joint may become a predetermined one, whereby an arc point can automatically follow said weld line, characterized in that

the average and effective values of the welding current, a consumable electrode feeding speed and a voltage between said tip (3) and said work (12) are detected,

said detected quantities are arithmetically processed by means of a computer (24) to determine a distance $L=L_E+L_A$ between said tip (3) and a weld metal (20), with L_A=arc length and L_E=extension length of said consumable electrode (6) extending from the tip (3) of said welding torch (1), and the deviation between the oscillation center of said welding torch (1) and the center of the joint is detected from the difference in said distance L between said tip (3) and said weld metal (20) in at least two predetermined oscillation positions."

III. An opposition was filed against the European patent requesting it be revoked on the grounds of lack of inventive step. The following documents were referred to:

(A) DVS-Berichte, Bd.65, 1980, pages 125-131;
(B) CH-A-611 824.

In the further course of the opposition proceedings the Opponent referred also to documents cited in the description of the patent in suit:

(C) "Investigations on Current Controlled Arc Welding", Welding Law Committee of Welding Association, July 1980;

(D) Kohhei Ando et al: "Supplement of Welding Arc Phenomena", Sanpoh, page 105.

IV. After considering the Grounds for Opposition, the Opposition Division rejected the opposition by the decision dispatched on 28 November 1988.

V. On 1 February 1989, the Appellant (Opponent) filed an appeal against the decision, paying the appropriate fee simultaneously.

VI. The Statement of Grounds was received on 7 April 1989. Together with the statement the Appellant submitted the German version of the documents (C) and (D).

The Appellant's objections can be summarised as follows: The subject-matter of the Claim as granted differs from the prior art as known from the above documents only in that, instead of the welding current, it is the total distance from the leading end of the tip of the welding torch to the weld which is derived from the welding current and the electrode feeding speed. The known control

method and the method as specified in the Claim of the patent in suit are based on the same principle. If the functional relationships between the different parameters as mentioned in the Claim are known, the processing of these functional relationships by means of a computer for obtaining equivalent control parameters cannot be considered to be inventive. If, on the other hand, the functional relationships of the different parameters are not known from the prior art, the question arises whether the invention is really disclosed in a manner so clear and complete for it to be carried out by a person skilled in the art (Articles 83 and 100(b) EPC).

VII. The Appellant requested that the decision under appeal is set aside, and the patent be revoked.

The Respondent requested to dismiss the appeal.

Reasons for the Decision

1. The appeal is admissible.

2. The examination of the documents (C) and (D) revealed that these documents disclose the functional relationships between the different parameters being essential for the claimed method, which relationships are mentioned to be known from said documents in the description of the patent in suit (cf. column 4, line 47 to column 5, line 3). Said documents are, therefore, relevant for the assessment of the patentability of the subject-matter of the Claim.

3. In his Statement of Grounds the Appellant submits for the first time the objection that the patent in suit does not disclose the invention in a manner sufficiently clear and complete for it to be carried out by a person skilled in the art (Article 100(b) EPC). This objection is however

not correct because the functional relationships between the different parameters, as well as a manner to calculate them are clearly and sufficiently disclosed in the present European patent.

4. Closest state of the art

According to the findings of the Board of Appeal, document (A) discloses the prior art which is the closest to the subject-matter of the Claim as granted, since Section 2 describes a method of arc welding a workpiece having a weld joint by oscillating the welding torch. In the case where the welding torch carries out the welding in a correct positional relationship with respect to the welding line, namely when the oscillation centre of the welding torch is positioned above the centre of the weld joint symmetrically with respect to the workpieces to be welded, the arc lengths from the leading end of the electrode to the weld metal and the values of the flowing welding current are equal to each other at both ends of the oscillation. However, when the oscillation centre departs from said centre of the weld joint, then the length of one of said arc lengths at one end of the oscillation increases and the length of the arc length at the other end decreases, which results in different values of the corresponding welding current. These different values of the welding current are detected and subjected to comparison, so that the horizontal position of the oscillation centre is controlled at all times according to the comparison result signal.

Additionally, the control of the height of the welding torch with respect to the weld joint is effected by comparing the detected average value of the welding current (actual value) with a desired value.

Therefore, the positional relationship between the oscillation centre and the centre of the joint is a predetermined one, whereby the arc point can automatically follow the weld line.

5. Problem and solution

5.1 Document (A) describes the disadvantageous dependency of the control of the position of the welding torch on the fluctuations of the consumable electrode feeding speed and power supply voltage.

According to section 3 of document (A), the evaluation of the parameter welding current can be considerably affected by an irregular electrode feeding speed. Therefore, a device has been proposed which permits a very regular electrode feeding speed to be used, so that the corresponding known method can always be performed at said rather constant electrode feeding speed (cf. page 125, right column, section 2.1, first sentence and page 128, left column, last sentence).

From section 5 of document (A) it is further known to keep also the voltage constant by the use of a power source with automatic compensation, which avoids any interference with the welding current due to voltage fluctuation.

Therefore, the control of the position of the welding torch relies only on the changes in the welding current as the exclusive parameter for sensing the weld line. Such a dependency, however, imparts undesirable results to the welding when the average and effective values of the welding are different. This affects the accuracy of the weld line and restricts, as a result, the use of the known welding method.

The technical problem to be solved by the invention is, therefore, to provide an automatic weld line following method having a high accuracy.

5.2 According to the teaching of the Claim as granted this problem is essentially solved by detecting the average and effective values of the welding current, the electrode feeding speed and the voltage between the torch tip and the workpiece, and by processing the detected parameters to determine automatically the optimal distance between this tip of the welding torch and the workpiece. This permits the control of the oscillation angle to be symmetric at all times with respect to the weld line which results in a highly accurate welding operation (cf. also EP-B-0 111 110, column 7, lines 37 to 60).

6. **Novelty**

Since none of the other available documents discloses an arc welding method which comes closer to the subject-matter of the claim as granted than the method known from document (A), the subject-matter as specified in said claim is to be considered novel within the meaning of Article 54 EPC.

7. **Inventive step**

7.1 The teaching of document (A) is clearly to keep constant the electrode feeding speed and the voltage between the tip of the welding torch and the work to be welded (cf. above section 5.1) by improving those parts of a welding device, which can influence the correct welding current measurement. Therefore, document (A) does not contain any details with respect to the specific detection of the voltage between the tip of the welding torch and the workpiece to be welded on the one hand and the use of the specific distance between the tip and the workpiece, let

alone the calculation of said specific distance on the other hand.

Consequently, no suggestion can be derived from the disclosure of said document to process said detected parameters for the determination of a distance between the tip of the welding torch and the weld metal, and for the detection of a deviation as defined in the claim, which deviation is used for controlling the position of said torch to achieve a welding operation of high accuracy.

7.2 Document (C) concerns mainly the speed of the melting of the consumable electrode and the functional relationship of said melting speed with the welding current and the voltage. Document (D) discloses the relationship between the welding current, the arc length and the arc voltage.

However, even if the value of the extension length of the wire from the leading end of the tip to the arc and the value of the arc length from the leading end of the wire to the weld metal are derived from the welding parameters by means of the known calculation formulae as already acknowledged in the description of the patent in suit (column 4, line 62 to column 5, line 5), the documents do not give any hint to a method which comprises the steps of detecting the aforementioned parameters during the course of welding, processing in real time the detected values by an electronic computer and applying the results thereof to control the position of the welding torch.

The documents (C) and (D), therefore, illustrate only the general knowledge of the person skilled in the art, which has no decisive effect on the issues considered.

7.3 The other available documents give likewise no hint to the subject-matter of the Claim. Their teachings could not, either alone or in combination with the teachings of the

documents discussed in the foregoing paragraphs, lead the person skilled in the art to a method according to the Claim.

7.4 The Appellant failed to provide any convincing evidence for his objection that the processing of the known functional relationships by means of a computer for the determination of the distance between the tip of the torch and the weld metal as the control parameter is not inventive.

7.5 Therefore, the subject-matter of the Claim involves an inventive step within the meaning of Article 56 EPC.

8. In view of the above the patent can be maintained as granted.

Order

For these reasons, it is decided that:

The appeal is dismissed.

The Registrar: **The Chairman:**

N.Maslin

C. Andries

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