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D E C I S I O N
of 20 April 1999

Case Number: T 0619/96 - 3.2.2

Application Number: 87904330.5

Publication Number: 0273984

IPC: B23K 11/24

Language of the proceedings: EN

Title of invention:
Seam welding apparatus

Patentee:
N.P.W. Technical Laboratory, Co., et al

Opponent:
Soudronic AG

Headword:
-

Relevant legal provisions:
EPC Art. 56(2)

Keyword:
"Inventive step (no)"

Decisions cited:
-

Catchword:
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Beschwerdekammern | Boards of Appeal | Chambres de recours

Case Number: T 0619/96 - 3.2.2

D E C I S I O N
of the Technical Board of Appeal 3.2.2
of 20 April 1999

Appellant: (Opponent)
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Decision under appeal: **Decision of the Opposition Division of the European Patent Office posted 30 April 1996 rejecting the opposition filed against European patent No. 0 273 984 pursuant to Article 102(2) EPC.**

Composition of the Board:

Chairman: W. D. Weiß
Members: M. G. Noël
J. C. M. De Preter

Summary of Facts and Submissions

I. European patent No. 0 273 984 was granted on the basis of European patent application No. 87 904 330.5 (International application No. PCT/JP87/00481).

II. Following an opposition filed by the appellant against the European patent and based on prior art document (3) US-A-4 144 440 in combination with a prior use, the Opposition Division decided on 30 April 1996 to reject the opposition and to maintain the European patent as granted.

III. The appellant lodged an appeal on 4 July 1996 against the decision of the first instance, filed a statement of grounds and paid the appeal fee in the appropriate time-limit.

In a subsequent reply dated 28 November 1997, the appellant filed a new document (9) US-A-4 574 176 emerging from parallel proceedings in Japan. As a result of this new evidence, it requested revocation of the European patent for lack of inventive step of its subject-matter vis-à-vis document (9) alone or in combination with document (3). As an auxiliary request, the holding of oral proceedings.

IV. In a communication of the Board dated 18 January 1999 accompanying the summons to oral proceedings, the parties were informed that late filed document (9) appeared to be more relevant than the prior use considered previously by the first instance. Since the disclosures of documents (9) and (3) were likely to

destroy the inventive step of the claimed subject-matter, it was the Board's intention to introduce document (9) into the present proceedings in accordance with Article 114(1) EPC. As a consequence, the respondent was invited to comment.

V. The respondent replied to the appellant's statement of grounds, but remained silent about the new line of arguments based on document (9). Then, in response to the summons to oral proceedings it decided to abandon the national parts of its European patent by non-payment of the annuity fees and to withdraw its request for oral proceedings.

VI. As a consequence, the Board decided to cancel the oral proceedings and to decide on the file as it stands.

VII. The appellant requests that the decision under appeal be set aside and that the patent be revoked.

The respondent requests that the appeal be dismissed.

VIII. In their written submissions, the parties argued as follows:

(i) The appellant:

With respect to document (9) which disclosed a continuous seam welding apparatus using a pulsed laser for making a continuous weld consisting of a plurality of overlapping spot welds and a shaft encoder for continuously detecting the position of a tubular sheet member to be welded as it moved past the pulsed laser, the seam welding apparatus according to claim 1 in suit only differed by the provision of wire electrodes running along the outer peripheries of roller electrodes supplied with welding current and by an approach switch for

detecting the position of a slit in a disk-like member and thereby the angular position of a feed arm for controllably feeding the overlapping edges of the cylindrical body to be seam-welded.

These features were not inventive since the feeding motion of the cylindrical bodies to be welded were the same in both cases, regardless of the welding means to be used. The use of roller electrodes was generally known, in particular from document (3), and the detection of a slit for determining the position of a moving piece was also common in the art. Since, on the other hand, the use of two sensors, of which one for detecting the leading and trailing edges of the cylindrical bodies and the other for controlling the forward motion of successive said bodies were also known from document (9), the subject-matter of claim 1 in suit was directly derivable from the teaching of the above prior art documents, having regard to the common general knowledge of a skilled person.

(ii) The respondent:

The principal object of document (3) was to avoid the burning and scorching of the opposite edges of a workpiece (blank) during a welding operation while the overlapping contacting edges were joined together by roll seam welding to thereby obtain a leakage-tight seam. The apparatus served to control the start and stop of the seam welding by positioning the blank as a function of time with respect to its ends in dependence on the frequency and the phase of the welding current. In this way, the first and last welding spots were applied at an adjustable spacing from respective leading and trailing ends of the blank. In contrast thereto, the present invention provided for a seam welding

apparatus which solved a problem similar to that addressed in document (3), but did so using different means and different operational methods.

No comments were made with respect to the disclosure of document (9).

IX. Claim 1 as granted reads as follows (identifying letter (a) to (i) added by the Board for ease of reference):

"(a) A seam welding apparatus with upper and lower roller electrodes (1, 2) disposed opposite to each other, in which apparatus a cylindrical body to be seam-welded which has an overlap section (S) formed by overlapping either edges of a metal plate or a surface-treated metal plate is fed between said roller electrodes (1, 2) and said overlap section is pressed and welded by using said roller electrodes (1, 2), in which said apparatus comprises:

(b) a welding current source circuit (8) for supplying a welding current to each of said roller electrodes (1, 2);

(c) feeding means for feeding said overlap section (S) between said roller electrodes (1, 2);

(d) a detecting means (6a) for detecting leading (4a) and trailing (4b) edges of said cylindrical body, said detecting means (6a) being disposed at a position spaced apart from a line connecting the axes (1a, 2a) of rotation of said roller electrodes (1, 2) in a direction opposite to the direction of feeding of said cylindrical body; and

(e) a control circuit (7) connected to an output side of said detecting means (6a) and to the welding current source circuit (8), said control circuit determining start and stop times of welding current supplied to said roller electrodes (1, 2), **characterized** in that

(f) the welding apparatus uses wire electrodes (3) running along outer peripheries of the roller electrodes,

(g) the feeding means feed by pushing a trailing edge (4b) of said cylindrical body, said feeding means including a disk-like member (13) rotatable about a shaft (11) disposed at a center of said disk-like member, a slit (9) defined in said disk-like member and a feed arm (12) having one end mounted on said shaft (11) and another end adapted to engage said trailing edge (4b) of said cylindrical body;

(h) an approach switch (14) is connected to the control circuit (7) and provided for detecting a position of said slit (9), said position corresponding to an indication that a leading edge (4a) of said cylindrical body is disposed at a nip between said roller electrodes (1, 2);

(i) that the control circuit (7) calculates from an output pulse of the approach switch (14) the instant of reaching the position between the upper and lower roller electrodes (1, 2) by the leading edge of the cylindrical body and calculating from an output pulse of the detecting means (6a) the instant of reaching the position between the upper and lower roller electrodes (1, 2) by the trailing edge of the cylindrical body, so that start and stop timings of supply of the welding current are

determined and that according to these timings the control circuit (7) supplies a welding current pattern to the welding current source circuit (8)"

Reasons for the Decision

1. The appeal is admissible.

2. *Closest state of the art and comparison with claim 1*

2.1 Document (3) referred to in the background part of the contested patent is considered as the closest prior art. It discloses all features recited in the precharacterising portion of claim 1. In particular (cf. Figures 1 and 2), workpieces or blanks 12 to be seam-welded are pushed by means of a chain conveyor 10 between a pair of welding electrode rollers supplied with welding current from a power network via a phase-controlled transformer 14. The chain conveyor and the electrode rollers are separately driven by a pair of stepping motors 9, 4, respectively. A detector 13 is provided upstream of the welding rollers (seen in the travel direction of the blanks) for successively detecting the leading and trailing edges 12a, 12b of a blank as it passes the detector element. The detected signals are then processed in a computer, from which control signals are delivered to the stepping motors and welding signals to the electrode rollers.

The object of document (3) is to provide a welding seam which is offset by distances a (front spacing) and b (end spacing) from the leading and the trailing edges of the blank, respectively, so that the first welding spot 16_1 starts at distance a and the last welding spot 16_n terminates at distance b. Since the welding spots or nuggets are defined by the cycle of the alternating

welding current Iw, its phase must have the value zero or 360° for the welding seam to encompass an entire number of welding spots-pairs. To this end, the velocities of the motors 9 and 4 are controlled by trigger signals F and F' delivered by the detector 13 at the times the leading and trailing edges of the blank reach the detecting position, respectively. Trigger signal F controls the advance of the blank by regulating the velocity of motor 9 in regulator 70 (cf. Figure 5) till engagement of the leading edge 12a at the nip between the welding rolls, such that the first condition (phase zero at front spacing a) is realised. Thereafter, the blank is moved at a constant speed by the stepping motor 4 up to the spacing position from which the welding operation is actually started and the first welding spot is realised. When the blank trailing edge 12b reaches the detector, the velocity of motor 4 is controlled by trigger signal F' to make sure that the second condition (phase zero at end spacing b) will be realised for the last welding spot.

2.2 The disclosure of document (3) is distinguished from the subject-matter of claim 1 in suit by the following features:

- The feed mechanism comprises a chain conveyor whereas, according to the present patent, the feeding means include a disk-like member and a feed arm.

- The electrode rollers are driven by a second motor 4 whereas, according to the patent, the rollers are rotated by the pulling force of wire electrodes.

- The first and last welding spots are applied at spacings a and b from the leading and the trailing edges of the blank whereas, according to the patent, the welding seam is formed from the leading edge of the body up to the trailing edge thereof.

- Only one detector is used for detecting the leading and trailing edges of the blank whereas, in the patent, a second detector 14 is used in the form of an approach switch for determining the position of the leading edge as it is introduced between the roller electrodes.

- The control circuit controls the velocities of the driving motors so as to respect the conditions imposed on the phase of the welding current at the offset positions a and b whereas, according to the patent, start and stop timings for supplying the welding current are determined from specific positions of the detected leading and trailing edges so that a welding current pattern is formed in the control unit 7.

2.3 It results therefrom that the subject-matter of claim 1 in suit differs from the disclosure of document (3) by the characterising features (f) to (i).

3. *Inventive step*

3.1 With respect to document (3) which discloses a seam welding apparatus having upper and lower roller electrodes and further comprising detecting and control means in accordance with the precharacterising portion of claim 1, the invention consists essentially in the provision of an approach detector for indirectly detecting the position of the leading edge of the

cylindrical body as it being engaged between the rollers (feature (h)) and in controlling the timing of supply of the welding current in relation to the signals provided by the two detectors (feature (i)).

These features solve the problem addressed in the patent in suit (cf. column 2, lines 23 to 32) of accurately starting and stopping the welding current at the exact times the leading and trailing edges of the body reach a position between the roller electrodes which coincide with the line L connecting the roller axes (cf. paragraph bridging columns 7 and 8 and column 11, lines 26 to 32).

3.2 Document (9) discloses an apparatus for forming a continuous weld in a member moving at high speed in front of a laser welding device. The members to be welded are transported by two advancing means, successively. The members are at first formed as tubular members 2 and then advanced at a variable speed (cf. Figure 21) by a chain conveyor 4 provided with a plurality of pushing fingers 57. Subsequently, the tubular members are taken over at a constant speed by a belt conveyor 7 moved by a driving shaft 24 (Figure 2) and provided with pushing fingers 11. The fingers 11 and 57 of the two conveyors are coordinated for simultaneously engaging the trailing edge of a tubular member while it being transferred from the first to the second conveyor. The position of the moving members are successively detected by a pair of detectors 96 and 97 placed respectively upstream and downstream of the welding laser beam 6. The detected signals are then processed in a control unit 98 (Figure 28) and the resulting output signals are used for controlling different laser parameters, of which the laser pulses in relation to the distance of the tubular member from the position of the welding laser, as shown in Figure 24.

Detector 96 detects the leading and the trailing edges of a moving member whereas detector 97 is a shaft encoder connected to the drive shaft of the second conveyor for providing pulses to the control unit 98. Detector 97 detects the position of any point of a member as it moves past the pulsed laser, each pulse or increment of rotation of the shaft corresponding to an increment of translation of the member. Since the detected member is moving at a constant speed between first and second positions B and D (Figure 21) and since the distance between the detectors, the position of the laser and the length of the members are known, by counting the pulses from the time the leading and tailing edges of a member are detected, any distance or the position of any point on the moving member can be determined and laser firing or pulsing can be accurately controlled with respect to both the leading and trailing edges of the member.

The welding apparatus according to document (9) works as follows with reference to Figures 24 to 28. As soon as the detector 96 has detected the leading edge of the moving member, a counter 109 counts the pulses delivered by the encoder 97. At the same time, the laser is set at low power P_1. It is of no consequence that this level of power is not sufficient to cause welding, because the member to be welded has still not arrived at the position under the laser. As soon as the leading edge of the member arrives under the laser beam at position D1, that is, after having counted 6727 pulses in counter 109 according to the described embodiment, the welding operation is started and the laser power at the output of digital-to-analog converter 114 is progressively increased for a period of time corresponding to fifteen additional pulses counted in counter 113 over a distance D1-D2. This distance corresponds to the ramp of increase from low power level P_1 to higher power level P_2. A reverse

process takes place at the end of the welding operation, whereby the laser power is progressively decreased from higher power level P_2 at position D3 to lower power level P_3 at position D_4 which corresponds to the trailing edge of the member under the laser. Moreover, the laser pulse pitch is controlled during the welding operation by a pulse pitch adjuster 108 which receives the output pulses from the encoder 97.

3.3 Therefore, like in the present patent, the welding apparatus disclosed in document (9) is capable of accurately controlling the welding power in relation to the exact position of the moving member to be welded, in particular the timings of supply of the welding current at any location over the length of the member, i.e. also at the edges. Further, the known apparatus allows for accurate control of the welding duration and timing by controlling the ramp slop and the pitch of the individual spot welds.

Claim 1 in suit differs from the disclosure of document (9) by some specific means such as, for example, an approach switch for detecting the position of a slit on a rotatable disk-like member whereas, in document (9), the detector (encoder) 97 detects increments of rotation of a driving shaft. Further, in the present patent, the start and stop timings of supply of the welding current are determined by preset times ΔT_1, ΔT_2 whereas in document (9) the welding is initiated and terminated by counting pulses. However, in both cases, the functions and the technical effects to be obtained are the same.

Since the principle of controlling the welding current as generally claimed in feature (i) is known from document (9), which relates to the same technical field and, like the present patent, aims at improving conventional electrical welding resistance apparatus,

it is of minor importance whether document (9) differs in some specific means. The controlling operation disclosed in document (9) thus can be identically applied in document (3). The only modification still to be made in document (3) to arrive at the claimed subject-matter is to make use of a second detector associated with the driving wheel 6 and to suitably process the detected signals in the control unit 15, both measures being generally known *per se* from document (9). Remaining features such as the use of "wire electrodes" or of a "slit" are not considered essential to the invention having regard to the problem to be solved and, therefore, cannot support the presence of any inventive step.

3.4 From the foregoing, it results that the subject-matter of claim 1 lacks an inventive step within the meaning of Article 56 EPC having regard to the combination of the teachings of documents (3) and (9).

Order

For these reasons it is decided that:

1. The decision under appeal is set aside.

2. The European patent is revoked.

The Registrar: The Chairman:

S. Fabiani W. D. Weiß