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D E C I S I O N
of 26 November 2002

Case Number: T 0888/99 - 3.2.6

Application Number: 92306182.4

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Title of invention:

High production laser welding assembly and method

Patentee:

AK Steel Corporation

Opponent:

Thyssen Stahl AG

Headword:

-

Relevant legal provisions:

EPC Art. 54, 56, 123

Keyword:

"Amendments (allowable)"

"Novelty (yes)"

"Inventive step (yes)"

Decisions cited:

-

Catchword:

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Boards of Appeal

Chambres de recours

Case Number: T 0888/99 - 3.2.6

D E C I S I O N
of the Technical Board of Appeal 3.2.6
of 26 November 2002

Appellant: Thyssen Stahl AG
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Representative: Fisher, Adrian John
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Decision under appeal: Interlocutory decision of the Opposition Division
of the European Patent Office posted 12 July 1999
concerning maintenance of European patent
No. 0 522 811 in amended form.

Composition of the Board:

Chairman: P. Alting van Geusau
Members: H. Meinders
M.-B. Tardo-Dino

Summary of Facts and Submissions

- I. The appeal is from the interlocutory decision of the Opposition Division announced on 14 June 1999 and posted on 12 July 1999 maintaining European Patent No. 0 522 811 in amended form.
- II. In its decision the Opposition Division considered that the subject-matter of claims 1 and 14 as filed with letter of 8 September 1998 was novel and inventive over:
- D1: DE-A-3 626 974, relied upon by the opponent.
- III. Against this decision an appeal was filed by the appellant-opponent on 7 September 1999, with payment of the appeal fee on that day. The statement of grounds of appeal was received on 7 October 1999. In this statement the appellant-opponent relied upon the following additional documents:
- D5: DE-A-3 910 495
- D6: US-A-3 544 752
- D7: "Leistungssteigerung durch Schwerkraft- und Federkraftlichtbogenschweißen", Schweißen und Schneiden 22 (1970), Vol. 3, pages 102 to 105.
- IV. In preparation of oral proceedings the Board sent a communication expressing as its preliminary opinion that D6 and D7 appeared to be no more relevant than the documents filed during the opposition proceedings.

V. Oral proceedings were held on 26 November 2002.

The appellant-opponent requested setting aside the decision of the Opposition Division and revocation of the patent.

The respondent-patentee requested setting aside the decision under appeal and maintenance of the patent in amended form based on claims 1 to 18 and description columns 1 to 10 as filed in the oral proceedings before the Board and Figures 1 to 6 as granted.

Independent claim 1 of this request reads as follows:

"A laser welding apparatus (10,210) for butt welding metallic sheets (12,13,212,213) along a common seam line (15), said apparatus comprising:

- a welding table (20,220) having an upper surface (34,234) for said metallic sheets (12,13,212,213), said table (20) having a longitudinal axis (L) aligned with said common seam line (15), a transverse axis (T) substantially perpendicular to said longitudinal axis (L), and a pair of transversely spaced side edges (38,39,238,239);
- a plurality of substantially identical laser welding devices (50,250) mounted above said upper table support surface (34,234) and positioned such that their welding beams will be directed along said common seam line (15), said welding devices (50,250) being effectively spaced from one another along said longitudinal axis (L), and means (163) for independently adjusting said welding beams in a direction parallel to said transverse axis (T)

to track said common seam line (15);

- first and second means (17,18,217,218) for loading onto said table upper support surface (34,234) a first sheet(12,212) generally along said transverse axis (T) from one side edge (38,238) of said table (20,220), and a second sheet (13,213) generally along said transverse axis (T) from the other side edge (39,239) of said table (20,220);
- means (36,285,289) for aligning said metallic sheets (12,13,212,213) on said table upper support surface (34,234) in abutting relationship along said common seam line (15), said aligning means comprising means (36,285,289) for relatively moving said sheets (12,13,212,213) inwardly along said transverse axis (T) into close alignment along said common seam line (15);
- means (25,255) for simultaneously moving said welding devices (50,250) relative to said common seam line (15) along said longitudinal axis (L), and means for simultaneously operating said welding devices (50,250) to weld said aligned sheets (12,13,212,213) together, said length of said relative movement of each welding device (50,250) being greater than the longest one of said spacing distances (X) between adjacent welding devices (50,250), to insure some overlap of welding along said common seam line (15),
- and an unloading device (93,293) for removal of a welded sheet (12-13, 212-213) from said welding table (20,220)".

Claim 14 reads:

"An method for butt welding a plurality of metallic sheets (12,13,212,213) along a relatively long common seam line (15) between said sheets (12,13,212,213), said method comprising the following steps:

- providing a welding table (20,220) having an upper support surface (34,234) on which a plurality of metallic sheets (12,13,212,213) may be supported for welding along a common seam line (15), a longitudinal axis (L) along which said common seam line (15) will be aligned, a transverse axis (T) substantially perpendicular to said longitudinal axis (L), and a pair of transversely oppositely spaced side edges (38,39,238,239);
- locating a plurality of substantially identical laser welding devices (50,250) above said upper support surface (34,234) of said table (20,220) and aligning said devices (50,250) such that their welding beams will be directed along said common seam line (15), spacing said welding devices (50,250) at a spacing distance (X) from one another along said longitudinal axis (L), and each welding device being independently adjustable in a direction parallel to said transverse axis (T) to track said common seam line (15);
- loading a plurality of sheets (12,13,212,213) to be butt welded onto said upper support surface (34,234) said loading step including the steps of providing a first sheet (12,212) generally along said transverse axis (T) from a first side edge (38,238) of said table (20,220), and providing a

second sheet (13,213) generally along said transverse axis (T) and from the opposite side edge (39,239) of said table (20,220);

- aligning proximal edges of said metallic sheets (12,13,212,213) on said upper surface in abutting relationship along said common seam line (15);
- simultaneously operating said welding devices (50,250) while providing relative movement between said welding beams and said seam line (15) along said longitudinal axis (L), causing such welding beam to weld only a portion of said sheets (12,13,212,213) along said common seam line (15) and insuring some overlap of welding along said common seam line (15) by causing said relative movement to extend along said longitudinal axis (L) for a length which is greater than said spacing distance (X); and
- unloading said welded sheets (12-13,212-213) by moving them in a direction substantially parallel to said longitudinal axis (L), and said common seam line (15)".

VI. The arguments of the appellant-opponent can be summarised as follows:

Novelty was not at stake, only inventive step. D1 was considered to constitute the closest prior art, from which the apparatus and method of claims 1 and 14 distinguished themselves by the provision of:

- means for loading the sheets generally along a transverse axis and means for unloading the welded

sheets

- a plurality of laser welding heads mounted such that their welding beams will be directed along the common seam line,
- means for independently adjusting the welding beams in a direction parallel to the transverse axis to track the common seam line
- the length of the relative movement of the welding devices being greater than the longest one of the distances between adjacent welding devices.

The first feature had no combinatory effect with the remaining features and as such could not provide inventive merit, as in D1 some kind of loading from the sides had to take place, otherwise there was no need to lift the aligning means (23) and (24) shown in the preferred embodiment of that document. Unloading means for the welded plates were, as such, evident.

If a longer seam was to be welded, it was normal practice, as in other fields of technology, to split up the work in smaller sections upon which simultaneously the necessary action was performed. Thus for longer seams the single welding head would be replaced without the exercise of inventive skills by a plurality of welding heads along the seam line, such as was also disclosed in D5, where 4 or 5 welding heads were arranged along one and the same welding line for joining wheel rims to hubs. Following the location of the seam line was in any case a necessity as was already recognised in D1 with the linear diode array camera ("Diodenzeilenkamera") used to control the

position of the welding head with respect to the seam line (column 4, lines 34 to 36 and column 6, lines 6 to 12). Controlling the position of a plurality of welding heads transverse to a seam line was not only known from D5 but also from D6. Therefore these features did not imply inventive step either.

VI. The respondent-patentee submitted the following counter-arguments:

As regards the admissibility of D6 it had no objections, in fact it found the document giving support to its argumentation for inventive step.

The problem solved by the apparatus and method according to the invention was not just how to speed up welding of relatively long seams, but also how to provide for the fact that the seam widens if one starts welding at one end as well as how to do this with laser welding, which requires a much more precise tracking of the seam. D1 is not related to large sheets, thus the problem does not occur with the apparatus disclosed therein.

D5 concerned a different kind of welding, namely arc welding, where accuracy is less important. In D5 as well as D6, which also concerns arc welding, it is merely necessary to initially transversely adjust the welding head to the position in which it should weld; after that it is left in that position, thus there is no adjustment "to track the common seam line" as claimed in claims 1 and 14. Furthermore, D6 proved that there were other solutions to increase the overall welding speed, e.g. by providing three welding heads welding the same spot over the other weld, thus

increasing material- and energy input per unit of time. Thus dividing the seam to be welded in a plurality of sections was not the only available possibility for the skilled person. Finally, it was not at all disclosed in D5 that the final welding beads were overlapping; the introduction, column 1, line 10 as well as claim 1 merely mentioned that the welding is done at separate points, at **tabs** ("Lappen"), thus not along the complete circumference of the wheel hub.

Reasons for the Decision

1. The appeal is admissible.
2. *Amendments (Article 123 EPC)*

The Opposition Division established in its decision that the admissibility of the amendments to the independent claims 1 and 14 had not been questioned by the opponent. It found that the amendments carried out by the patentee fulfilled the requirements of Article 123 EPC. The appellant-opponent did not contest that conclusion and the Board sees no reason to deviate from it.

Claim 1 as further amended in the appeal proceedings by the deletion of "a plurality of" in the feature "for independently adjusting a plurality of said welding beams" is also admissible pursuant to Article 123 EPC for the reasons that follow.

In the form as maintained by the Opposition Division it was possible that only a part of the welding beams was

adjustable, now the subject-matter of claim 1 is limited to all welding beams being adjustable. The basis for the amendment can be found in column 6, lines 47 to 55.

The amendments to the description are necessary to bring it into line with claim 1 as amended and are also not objectionable pursuant to Article 123 EPC.

3. *Admissibility of D6*

As the respondent-patentee had no objections to admitting D6, a document filed only upon appeal, and in fact wished to argue its case with its help, the Board has decided to admit D6 into the proceedings. D7 is not admitted into the appeal proceedings as it is no more relevant than the already available documents. In particular it does not relate to a plurality of welding heads along the welding line which are **simultaneously** operated.

4. *Novelty (Article 54 EPC)*

Novelty of the subject-matter of claim 1 has not been an issue in the opposition- or the appeal proceedings.

5. *Inventive step (Article 56 EPC)*

- 5.1 The parties agree that D1 constitutes the closest prior art for discussing inventive step of the subject-matter of claims 1 and 14. The Board has no reason to see this differently: D1 is in particular concerned with laser welding of the abutting edges of two sheets, while using a linear diode array camera("Diodenzeilenkamera") for adjusting the position of the single welding head

to track the seam.

When starting from the apparatus and method disclosed in D1 as closest prior art the main object of the invention in the patent in suit is to provide a laser sheet welding system which can cope with relatively long weld lengths, provide minimized weld time and optimized weld operation (see column 3, lines 17 to 40 of the patent in suit).

5.2 The subject-matter of claims 1 and 14 differ from the apparatus and method disclosed in D1 by the following features:

- means for loading and unloading generally along a transverse axis, one sheet from one edge of the welding table, the other from the opposite edge of the table,
- a plurality of laser welding heads mounted such that their welding beams will be directed along the common seam line,
- means for independently adjusting the welding beams in a direction parallel to the transverse axis to track the common seam line,
- the length of the relative movement of the welding devices being greater than the longest one of the distances between adjacent welding devices.

The Board is satisfied that these features solve the object of the invention as discussed above.

5.3 First, the feature of the plurality of laser welding

heads along the common seam line will be discussed:

The appellant-opponent argued that it was a generally accepted principle that when a large stretch of work was to be done, the work should be subdivided and executed simultaneously along the stretch, as was done in road construction and used to be done in potato harvesting. Evidence of such an approach in welding could be found in D5, where 4 or 5 welding heads operated simultaneously along a, albeit circular, welding line.

Considering this argumentation the Board draws attention to the fact that the general examples referred to by the appellant-opponent have nothing in common with laser welding of sheets, which requires a high level of accuracy. These remote general solutions will hardly trigger the mind of the skilled person working in the field of laser welding.

Considering now what is in fact disclosed in D5 and D6, it is to be noted that D5 discloses an arrangement for arc welding wheel rims to wheel hubs, in which there is no independent adjustment of the welding heads in a traverse direction of the seam **to track that seam line**. What can be derived is the initial adjustment of the welding head in respect of the location to be welded. The same can be derived from D6, where the arc welding heads are also only initially adjusted in respect of the welding location such that when travelling consecutively over the same location they supplement each other.

There is no mention whatsoever in D5 or D6 that during welding the seam line is to be tracked. That is

actually not necessary since with the arc welding arrangement of D5 or D6 material is added, thus the precision of tracking the location where this material is to be deposited is less important than with laser welding, where no material is added and the seam line has to be precisely followed.

Furthermore, in D5 it is mentioned that the hubs are fixed to the rims via tabs ("Lappen"), i.e. the welding is done at discrete locations. Thus it cannot be assumed that there will be overlapping welding lines.

- 5.4 The appellant-opponent further submitted in respect of the problem of avoiding deformation in relatively large sheets to be welded along their abutting edges, that the skilled person in such a case would first fix the line to be welded with a number of welding spots, distributed along the seam line and that thus he would use a plurality of welding beams distributed along the seam line.

The Board cannot follow the appellant-opponent in this argumentation, as such preventive welding points along the seams can just as well be achieved with the single welding head known from D1, by merely moving it to the required spots. Furthermore, the procedure mentioned may be useful in welding methods adding welding material, however with laser welding (where no material is supplemented) that procedure is not considered evident. No further evidence was produced by the appellant-opponent to substantiate his allegation.

Therefore the board comes to the conclusion that the provision of more than one laser welding head along the seam line, with means to individually adjust each

welding beam so as to track the seam line, does not follow in an obvious manner from the relevant prior art.

- 5.5 In view of the conclusion arrived at above, there is no need to discuss the distinguishing feature of the loading and unloading means for the sheets to be welded.

Therefore the Board concludes that the subject-matter of claims 1 and 14 involve inventive step (Article 56 EPC).

The subject-matter of dependent claims 2 to 13 and 15 to 18 is related to preferred embodiments of the apparatus of claim 1 and for preferred ways of carrying out the method of claim 14 (Rule 29(3) EPC), thus also fulfils the requirements as to novelty and inventive step.

Therefore the patent can be maintained in the amended form as requested by the respondent-patentee (Article 102(3) EPC).

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 with the following documents:

claims 1 to 18 and description columns 1 to 10 as filed during the oral proceedings before the Board and Figures 1 to 6 as granted.

The Registrar:

The Chairman:

M. Patin

P. Alting van Geusau