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D E C I S I O N
of 26 April 1994

Case Number: T 0034/92 - 3.2.5

Application Number: 85306675.1

Publication Number: 0195157

IPC: B21D 26/02

Language of the proceedings: EN

Title of invention:
Method of forming box-section frame members

Patentee:
TI Corporate Services Limited

Opponent:
Benteler AG

Headword:
-

Relevant legal norms:
EPC Art. 56

Keyword:
"Inventive step (yes)"

Decisions cited:
-

Headnote/Catchword:

Europäisches Patentamt | European Patent Office | Office européen des brevets

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Case Number: T 0034/92 - 3.2.5

D E C I S I O N
of the Technical Board of Appeal 3.2.5
of 26 April 1994

Appellant: (Opponent)
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Decision under appeal: **Decision of the Opposition Division of the European Patent Office dated 25 November 1991 rejecting the opposition filed against European patent No. 0 195 157 pursuant to Article 102(2) EPC.**

Composition of the Board:

Chairman: C.V. Payraudeau
Members: H.J. Seidenschwarz
H.P. Ostertag

Summary of Facts and Submissions

I. The Appellant (Opponent) lodged an appeal against the decision of the Opposition Division by which the opposition against the European patent No. 0 195 157 had been rejected pursuant to Article 102(2) EPC.

The documents D1 (Hydrostatic Forming of Tubing, Automation, June 1963, page 85), D2 (US-A-4 305 269) referred to in the reasons for the decision of the Opposition Division and D3 (US-A-4 238 878) cited in the European Search Report are relevant to the present decision.

II. Oral proceedings were held.

(i) The Appellant requested that the decision under appeal be set aside and that the patent be revoked.

(ii) The Respondent (Patentee) requested that the appeal be dismissed.

(iii) Claim 1 of the patent as granted reads as follows:

"1. Method of forming a box-section frame member of which at least an elongate portion (17) is of a uniform cross-section having at least two opposed and planar side faces (32, 33) **characterized by:**
providing a tubular blank (10) having a continuous, smooth, arcuate cross-section;
deforming the side walls of the blank inwardly in opposed areas of at least one elongate portion thereof corresponding in position to the planar side faces desired in the final frame

member and thereby providing the blank with a continuous, smooth, arcuate cross-section including opposed inwardly recessed concavely curved side-wall portions (32b, 33b);
enclosing the deformed tubular blank within a sectional die having at least two cooperating die sections (43, 44) defining an elongate cavity of approximately the shape of the deformed blank and which is throughout of smooth, continuous, cross-sectional profile and is in all transverse dimensions larger than the deformed blank and has an elongate planar side face opposing each concavely curved side wall portion of the blank;
expanding the blank circumferentially by application of internal fluid pressure until all exterior surfaces of the blank conform to the surfaces of the die cavity;
separating the die sections (43, 44); and
removing the expanded blank from the die."

(iv) The Appellant essentially argued as follows:

Document D1 discloses a method of forming a box-section frame member that comprises substantially five of the six steps according to Claim 1 of the patent in suit, i.e. providing a tubular blank, enclosing that blank within a die, expanding the blank, separating the die sections and removing the expanded blank.

Document D2 discloses a method for the manufacture of a front fork for a bicycle, which comprises the step of deforming the middle section of a tubular blank to a concave ellipse (cf. Figures 3, 4 and 7, in particular reference numeral 3a). The concave section is subsequently

expanded by a hydraulic bulge-forming process to form a box-section frame member (cf. crown 14 with socket 14a in Figure 8; see also column 5, lines 3 to 25), since it is generally known that the crowns of front forks have a rectangular section. Due to the concave deformation an excessively large circumferential deformation of the blank is avoided during the bulge-forming process.

The person skilled in the art seeking a greater dimensional uniformity of the end product would therefore regard it as a normal design option to include the step of deforming the side walls of the blank inwardly according to the method as specified in document D2 in the method described in document D1 in order to solve the problem posed. Furthermore, document D3 discloses (cf. Figure 2 and column 3, lines 18 to 33) the idea of deforming the side walls of tubs inwardly in opposed areas for solving exactly the same problem.

(v) The Respondent on his part submitted essentially as follows.

The patent in suit relates to a method of forming box-section frame members. In the known methods, tubes of usually circular or oval cross-section are confined in a die cavity and then expanded. The problem is that if the diameter of the circular tube is larger than the smallest cross-sectional diameter of the box-like shape die, the tube will become pinched when the die closes, which leads to uneven strength properties and substantive die wear. If, on the other hand, the tube is small enough

to fit in the die, an excessively large circumferential deformation of the blank is required which also adversely affects the quality of the final product.

The deformation step according to document D2 as referred to by the Appellant has nothing to do with the problem of avoiding pinching of a tubular blank in a die. The purpose of the concave indentation of the tube is to compensate for the effect that when a straight tube is bent to form a right-angled corner, the outer tubular wall is stretched, whereas the inner tubular wall is compressed (cf. column 5, lines 26 to 42). For that reason document D2 teaches explicitly to deform only one of two arcuated sides to a concave side.

Document D3 concerns a problem and a method which are different from the problem and the method as specified in the patent in dispute.

Reasons for the Decision

1. *Novelty*

It is not disputed by the parties that none of the documents D1 to D3 discloses all the features of Claim 1 of the patent in suit. There is no need for further substantiation of this matter.

The subject-matter of Claim 1 of the patent as granted is therefore new within the meaning of Article 54 EPC.

2. *The invention*

The invention relates to a method of forming box-like frame members.

The problem this invention seeks to solve is to provide an improved method which permits to expand tubular blanks in a sectional die by the application of an internal pressure without pinching the blank on closing of the die and without over-expanding parts of the blank contour during said application such that the blanks gets the strength properties and dimensional uniformity or repeatability and accuracy required for box-like constructional frame members (cf. column 1, line 40 to column 2, line 14 and column 2, lines 43 to 46, of the description).

This problem is solved by the method with the features as specified in Claim 1.

In particular, the side walls of the blank are deformed inwardly in opposed areas of at least one elongate portion thereof corresponding in position to the planar side faces desired in the final frame member and thereby providing the blank with a continuous, smooth, arcuate cross-section including opposed inwardly recessed concavely curved side-wall portions. This inward deformation of the side walls diminishes the cross-sectional outline of the blank, thus permitting it to be confined between a sectional forming die without the sections of the die pinching the blank on closing of the die. The inward deformation also permits the blank to be expanded to the desired box-like cross-section without excessively large circumferential expansion of the blank; in the expansion step during the application of an internal pressure the blank is expanded so that all its outer surfaces conform to the inside of the die

cavity, whereby the dimensions of the interior surfaces of the die cavity are reproduced with a high degree of accuracy and uniformity.

3. *Inventive Step*

3.1 Document D1 teaches a hydraulic bulging process for forming a tubing into a desired shape, whereby a high pressure fluid forces the tubing to start bulging so that the tubing follows the general contours of the die. Document D1 is, however, silent about deforming the opposed side walls of the tubing inwardly.

3.2 Document D2 discloses (cf. column 3, line 59 to column 4, line 5 and Figures 3 and 7) a method for the manufacture of a front fork blank for use in a bicycle, which comprises also the step of deforming the middle portion (3a) of a tubular blank (1) to a concave ellipse. The two end portions or blades (2b, 2c) of the straight tubular blank are then bent with the concave ellipse facing upwardly - outer tubular wall -, i.e. in the opposite direction to that of the blades (2b, 2c). In a following step, a socket (14a) is formed in the middle of the said middle portion (3a) by a hydraulic bulge-forming process (cf. column 5, lines 3 to 25 and Figure 9).

According to the description (cf. column 3, line 10 and line 63), the length of the concave deformation is greater than the length of the crown. Since the concave deformation is formed **before** bending the end portions, it follows that the bends are formed at the ends of the concavely deformed elliptical section. The purpose of the concave deformation is to compensate for thinning of the wall of the deformed tubular blank due to the bending operation (cf. column 5, lines 26 to 34). Therefore, such a concave deformation on the opposite

side - inner tubular wall - is not necessary, since the inner wall stretches and extends much less than the outer wall. From this results (see also Figure 9 and column 5, lines 43 to 54) that the concave deformation is not formed for avoiding pinching of the tubular blank in the region where the socket (14a) is to be formed by a corresponding recess (19a) of a mandrel (19).

Consequently, document D2 does not suggest to form a tubular blank to a box-like frame member within the meaning of the teaching of Claim 1 of the patent in suit.

3.3 Document D3 likewise gives no hint of the subject-matter of Claim 1 of the patent in suit because it concerns a problem quite different from the method the claimed invention aims to solve, i.e. it relates to a method of producing a controlled collapse of an elongated thin sheet metal rectangular inner tube during the manufacture of a shroud for storing radioactive spent nucluar fuel cells.

3.4 Therefore, the teaching of the documents discussed above could not, either alone or in combination with each other, lead the person skilled in the art to a method according to said Claim 1.

3.5 Hence, the subject-matter of Claim 1 involves an inventive step within the meaning of Article 56 EPC.

4. In view of the above, the patent as granted can be maintained with Claim 1 together with the dependent Claims 2 to 10 concerning particular embodiments of the subject-matter of Claim 1.

Order

For these reasons it is decided that:

The appeal is dismissed.

The Registrar: The Chairman:

A. Townend C. Payraudeau