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D E C I S I O N
of 22 April 2003

Case Number: T 1145/00 - 3.2.1

Application Number: 93306902.3

Publication Number: 0588528

IPC: B21D 26/02

Language of the proceedings: EN

Title of invention:
Apparatus and method for forming and hydropiercing a tubular frame member

Patentee:
Aquaform Inc

Opponent:
(i) Siempelkamp Pressen Systeme GmbH & Co.
(ii) Benteler AG

Headword:
-

Relevant legal provisions:
EPC Art. 56, 84, 123(2)(3)

Keyword:
"Claims - clarity (yes - after amendment)"
"Amendments - added subject-matter (no - after amendment)"
"Amendments - opposition proceedings"
"Inventive step (yes)"

Decisions cited:
-

Catchword:

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Beschwerdekammern | Boards of Appeal | Chambres de recours

Case Number: T 1145/00 - 3.2.1

D E C I S I O N
of the Technical Board of Appeal 3.2.1
of 22 April 2003

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Decision under appeal: **Interlocutory decision of the Opposition Division of the European Patent Office posted 9 October 2000 concerning maintenance of European patent No. 0 588 528 in amended form.**

Composition of the Board:

Chairman: S. Crane
Members: J. Osborne
M. K. S. Aúz Castro

Summary of Facts and Submissions

I. The appeal of opponent II is directed against the decision of the Opposition Division in which it was found that, account being taken of the amendments made by the patent proprietor during the opposition proceedings according to its main request, the European patent No. 0 588 528 and the invention to which it relates meet the requirements of the EPC.

II. The patent had been opposed on the grounds that the subject-matter of the claims as granted lacked novelty and inventive step. After amendment of the claims additional objections were raised in respect of clarity and addition of subject-matter.

III. The appellant argued in its grounds of appeal that the subject-matter of the independent claims lacked an inventive step and requested that the contested decision be set aside and that the patent be revoked. It referred to the following evidence which had been cited during the opposition procedure:

D1: US-A-4 567 743

D6: *Ogura et al.* "Über die Anwendung eines hydraulischen Ausbauchverfahrens", Industrie-Anzeiger, 10 May 1966, 107-110 and 17 June 1966, 137-140

D10: DE-U-75 14 200

IV. The Board summoned the parties to oral proceedings and in a communication pursuant to Article 11(2) RPBA indicated its opinion that the claims as accepted by

the Opposition Division failed to satisfy the requirement of clarity (Article 84 EPC) and contravened the provisions of Articles 123(2) and (3) EPC. Both the party as of right (opponent I) and the appellant indicated that they would not participate in the oral proceedings.

V. The respondent (patent proprietor) filed with a letter dated 21 February 2003 main and first auxiliary requests that the patent be maintained on the basis of respective claims 1 to 15 filed therewith. With a communication dated 21 February 2003 the Board cancelled the oral proceedings.

VI. The independent claims according to the respondent's main request read as follows, wherein wording additional to and removed from that as granted is indicated in italics and in [-] respectively:

Claim 1 (including correction of an obvious error in the word "pressurizing"):

"A method for forming a frame member having a complex shape *including at least one bend in said frame member and having a cross-sectional view configuration which is varied along the surface of the frame member formed* from a tubular blank (12) comprising the steps of: placing a *tubular* blank in an open die (38,40), filling the interior of the blank with an incompressible fluid, pressurizing the fluid in the interior of the blank, closing the die and increasing the pressure *of the fluid* within the blank, *creating an expanded tube by increasing the pressure of the fluid beyond the yield limit of the tube to expand the tube and* creating the frame member by altering [the elevational view

configuration and] the cross-sectional view configuration of the expanded tube, characterized by:
closing the die prior to increasing the pressure sufficiently to expand the tubular blank *to form the expanded tube*;
applying a compressive force to the opposed ends of the tubular blank during the step of increasing the *fluid* pressure within the blank to expand the tubular blank to conform it to the shape of the die, *then bending the expanded tube in a second die with the fluid filling the interior of the expanded tube, said fluid acting like a flexible mandrel to ensure substantially uniform non-buckling bending, wherein the resulting frame member has a complex shape including at least one bend and a cross-sectional view configuration which is varied along the surface of the frame member."*

Claim 14:

"An apparatus for forming a frame member having a complex shape from a tubular blank (12) including a *first* die (38, 40) for receiving the tubular blank, means (80, 86, 88) for applying sufficient pressure by an incompressible fluid to the interior of the tubular blank placed in the *first* die to conform the blank to the shape of the *first* die, and means for creating the frame member by altering the elevational view configuration and the cross-sectional view configuration of the expanded tube, characterized by:
first means (55, 42) for compressing the opposing ends of the tubular blank while the interior is pressurized to conform to the shape of the *first* die,
second means comprising a second die for bending the expanded tube while the expanded tube is filled with a

fluid, the fluid acting like a mandrel; and
means for maintaining a substantially constant pressure inside the frame member during bending of the member."

The claims according to the main request additionally contain dependent claims 2 to 13 and 15 which define features additional to the subject-matter of claims 1 and 14 respectively.

VII. The appellant's arguments in respect of the main request can be summarised as follows:

D1 discloses a method of forming a frame member of the type defined in present claim 1. According to D1, particularly column 6, line 65 to column 7, line 2, the blank is first expanded and then subjected to bending. Contrary to the finding of the Opposition Division, the sequence of performing the individual expansion and bending steps therefore is already known and the subject-matter of present claim 1 essentially differs from the prior art method merely in the details of these steps. These details are known from D6 and D10 respectively and the skilled person would arrive at the subject-matter of present claim 1 without exercising inventive skill by applying the teaching of D6 and D10 to the forming method according to D1.

The apparatus as defined in claim 14 comprises two items of equipment for deforming a tubular blank which are merely juxtaposed and are known individually from D6 and D10. It would be obvious for the skilled person to combine the teachings of these prior art documents and therefore arrive at the subject-matter of claim 14.

VIII. The respondent essentially rebutted the arguments of

the appellant by denying that D1 discloses the sequence of bending subsequent to expansion. It argued moreover that the application of compressive force to the opposed ends of the tubular blank during the expansion step was not disclosed by D1. The novel features of claim 1 in comparison with D1 solve the problem of achieving a greater degree of expansion in the frame member without causing rupture or excessive weakening of the material, which is not addressed in the prior art. A combination of D1, D6 and D10 would neither be obvious for the skilled person nor lead to the subject-matter of present claim 1.

Reasons for the Decision

Main request

Amendments

1. Newly introduced features in claim 1 were disclosed in the original application as follows:

"at least one bend in said frame member" - claim 3 in combination with page 40, lines 9 to 11;

"having a cross-sectional view configuration which is varied along the surface of the frame member" - page 5, lines 5 to 7;

"creating an expanded tube by increasing the pressure of the fluid beyond the yield limit of the tube to expand the tube" - page 24, lines 9 to 20;

"then bending the expanded tube in a second die" -

page 27, lines 14 to 16;

"with the fluid filling the interior of the expanded tube" - page 37, lines 17 to 21;

"said fluid acting like a flexible mandrel to ensure substantially uniform non-buckling bending" - page 38, lines 6 to 9.

2. The wording deleted from claim 1, relating to altering the elevational view configuration, has been replaced by the more detailed definition of the introduction of a bend.

3. The amendment in claim 14 relating to means for maintaining a substantially constant pressure inside the frame member during bending of the member is disclosed in the original application at page 38, line 21 to page 39, line 2.

4. From the above the Board concludes that the requirements of Articles 123(2) and (3) EPC are satisfied in respect of the amendments to the independent claims. The dependent claims differ from those as granted essentially only in order to ensure consistency with the amendments to the independent claims. The Board is also satisfied that none of the amendments renders the subject-matter of the claims unclear.

Inventive step

Claim 1

5. It is undisputed that the closest prior art is that

disclosed by D1. This prior art relates to the formation of a box-section frame member from a tubular blank, the frame member comprising a linear centre section and end sections formed at an angle to the centre section, some portions having two opposed, planar side faces. The tubular blank is a straight circular tube which in the first operation is bent to form the approximate configuration of the frame member i.e. a centre section and the respective end sections. This bending may be performed using conventional bending procedures with or without the use of a mandrel. In the next step the sections of the tube wall which will form the planar side faces are deformed inwardly to create a concavely curved cross-section. The thus modified blank is then inserted into a two-piece sectional die and fluid pressure is applied to the interior of the blank to expand it circumferentially to conform it to the walls of the die. The circumferential expansion is preferably no more than 5% in order avoid excessive weakening of the material but may be up to 20% if the material is heat treated. Whilst according to D1 it is preferred to perform the above-described sequence of bending the blank before inwardly deforming the walls, it is also disclosed that the bending operation may follow the inward-deformation step (column 6, line 65 to column 7, line 2). Contrary to the assertion of the appellant, however, there is no suggestion to bend the blank after the expansion step, i.e. after outwardly deforming the walls of the tubular blank.

5.1 It follows from the above that D1 discloses a method for forming a frame member having a complex shape including at least one bend and a cross-sectional view configuration which is varied along the surface of the

frame member, the method having the steps included in the preamble of present claim 1 together with that of closing the die prior to increasing the pressure sufficiently to expand the tubular blank to form the expanded tube. The subject-matter of present claim 1 therefore differs from that of D1 by:

(a) applying a compressive force to the opposed ends of the tubular blank during the step of increasing the fluid pressure within the blank to expand the tubular blank to conform it to the shape of the die,

(b) then

(c) bending the expanded tube in a second die with the fluid filling the interior of the expanded tube, the fluid acting like a flexible mandrel to ensure substantially uniform non-buckling bending.

The application of compressive force to the ends of the straight blank during expansion encourages material to flow into the areas in which the expansion takes place and so helps to maintain wall thickness in those areas (specification column 11, lines 40 to 50). As a result, a greater degree of expansion is possible without causing rupture or excessive weakening of the material; the degree of expansion may typically be 50% (specification column 12, lines 28 to 47). The sequence of expansion and bending steps according to present claim 1 permits the axial compressive forces to be applied to a straight blank. As a result of this functional relationship between the features which are novel in comparison with D1 they are to be considered in combination when assessing inventive step. They

solve the problem of achieving a high degree of expansion of a tubular blank by the application of internal pressure without causing rupture or excessive weakening of the material, when producing a frame member having at least one bend.

5.2 D6 summarises developments in the production of components from straight tubular blanks by the application of hydraulic pressure to the interior of the blank held in a die. Two groups of product are identified, one being produced merely by the application of internal pressure and the other with the additional application of compressive axial force. One example of a product which may be manufactured by the latter method is a motor vehicle rear axle housing. However, this concerns merely the housing, particularly for the differential, of a driving axle and no bending operation takes place (see "Bild 17"). Other products mentioned are T-fittings, pipe fittings and cycle frame lugs. Indeed, D6 contains no mention of a product in which a bending operation takes place and discloses the feature (a) only in respect of members having a relatively simple shape.

5.3 D10 concerns a method for forming a vehicle suspension component from a hollow profile. In the method movable sealing heads are connected to each end of the tubular blank which is then filled with a pressurised medium, inserted into a die and formed by closure of the die. The die acts to both bend and change the cross-section of the blank (see Figure 2) but there is no disclosure of any expansion step whether before, during or after this forming step.

6. No cited document addresses the problem of achieving a

high degree of expansion of a tubular blank by the application of internal pressure when producing a component having a complex shape including at least one bend. Moreover, a notional combination of the cited documents would not arrive at the subject-matter of present claim 1 because the sequence of performing the bending operation after that of expansion is neither disclosed nor rendered obvious by them in combination. The Board concludes that the subject-matter of claim 1 involves an inventive step. The same conclusion applies to the subject-matter of claims 2 to 13.

Claim 14

7. Claim 14 relates to an apparatus for forming a frame member having a complex shape from a tubular blank. It comprises a first means for compressing the opposing ends of a tubular blank positioned in a first die whilst the interior of the blank is pressurised to expand it to the shape of the die. The second means comprise a second die for bending the expanded tube whilst it is filled with fluid at a substantially constant pressure acting as a mandrel. The apparatus of claim 14 therefore corresponds to the method of claim 1 in as far as it is adapted to perform the bending operation after the expansion step. The subject-matter of claim 14 therefore involves an inventive step for the same reasons as for claim 1. This conclusion applies equally to claim 15.

In the light of the foregoing it is not necessary to consider the respondent's auxiliary request.

Order

For these reasons it is decided that:

1. The decision under appeal is set aside.

2. The matter is remitted to the first instance with the order to maintain the patent on the basis of the following documents:

   Claims 1 to 15 (main request) filed with the letter of 21 February 2003, received by facsimile on the same day;

   Description and figures as granted.

The Registrar: The Chairman:

S. Fabiani S. Crane