(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) EP 2 248 612 A1

(12) **EUROPEAN PATENT APPLICATION**

(43) Date of publication:
10.11.2010 Bulletin 2010/45

(51) Int Cl.:
B21D 9/15 *(2006.01)*

(21) Application number: **10161942.7**

(22) Date of filing: **05.05.2010**

(84) Designated Contracting States:
AL AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HR HU IE IS IT LI LT LU LV MC MK MT NL NO PL PT RO SE SI SK SM TR
Designated Extension States:
BA ME RS

(30) Priority: **06.05.2009 IT BS20090081**

(71) Applicants:
- **Punto Curvatura S.r.l.**
  25010 Acquafredda, Brescia (IT)
- **C.F.C. S.r.l.**
  25046 Cazzago S. Martino (BS) (IT)

(72) Inventors:
- **Faccin, Timothi**
  I-25018 Montichiari, Brescia (IT)
- **Renaldini, Giuseppe**
  25050 Ome, Brescia (IT)

(74) Representative: **Chimini, Francesco**
Jacobacci & Partners S.p.A.
Piazza della Vittoria 11
25122 Brescia (IT)

(54) **Bending Method and bending assembly for metal sections**

(57) The present invention relates to a method for bending metal sections, comprising a step of providing a container element (10), e.g. tubular or open box-shaped, having a wall (14) identifying a container cavity suitable for at least partially housing a section (P) to be bent in at least one bending plane (PC). In a subsequent step, the section (P) is inserted in the container cavity, the container cavity is filled with a filler material (F) and the container element is subjected to bending, e.g. roller-bending, to achieve a desired bending radius (R).

The present invention also relates to a bending assembly for performing the aforesaid method.

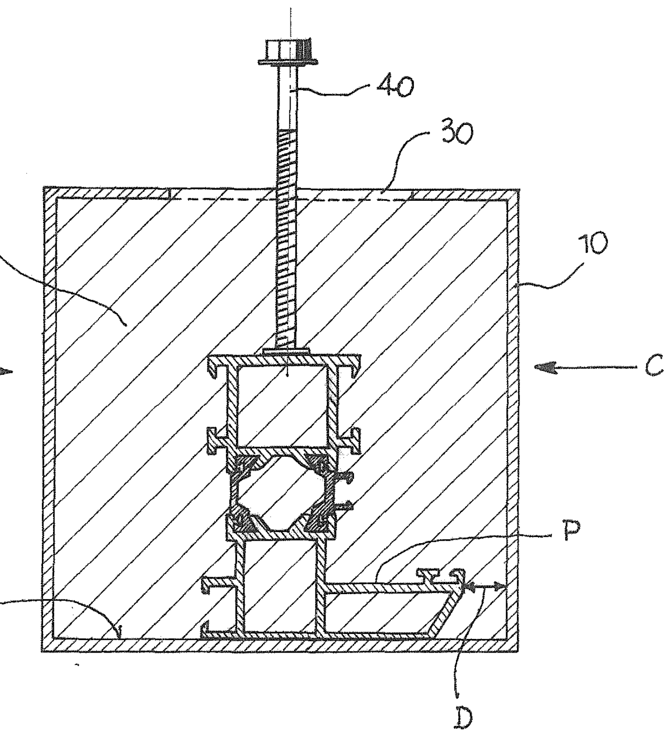


Fig. 4

EP 2 248 612 A1

Description

Background of the invention

[0001] . The present invention relates to a bending method for metal sections and to a bending assembly for performing such method.

State of the art

[0002] . The use of flat or bent metal sections, of varying cross sections, is common in the civil construction industry. Aluminium sections having a small, medium and large cross-section are widely used for example to make window fixtures, structural facades, shower cabins, refrigerated cabinets, sorting systems. The cross-section geometry of the sections varies depending on the type of application.

[0003] . The process of bending a section from a linear element to a bent element with a variable or constant radius requires the application of a bending moment which elasticises the material determining an elasto-plastic deformation and is distributed all over the section length by means of a rotation movement applied to the section itself.

[0004] . To this purpose machines provided with calendering rollers are normally used, fitted with special dies destined to come directly into contact with the section. The shape of the dies varies depending on the section to be bent.

[0005] . In a bending process, as well as considering the material lengthening it is essential to correctly calibrate the strain applied to the section so as to avoid exceeding the material elasto-plastic limit and therefore cause uncontrolled deformation and/or collapse of the section. To such end the yield point of the material and the bending modulus of the cross-section, which is a function of the size and shape of the section as well as of the direction of bending, need to be known.

[0006] . In the case of sections with different cross-sections, it must also be borne in mind that the bending modulus varies for each single section.

[0007] . As is known, a traditional bending process does not allow the bending of sections below a predefined bending radius which varies in relation to the material and the geometry of the section.

[0008] . Bending beyond the aforesaid predefined values leads to deformation of the section, to the detriment of the final quality of the product, and often causes the section to collapse.

[0009] . Deformations of the cross-section occurring at the ends of the section are particularly undesirable. In fact, the bent section is often part of a more complex structure and must be joined to segments of sections having an identical, non-deformed cross-section. Deformation of the bent section may make the join difficult if not impossible.

[0010] . The bending of sections with an open cross-section or of sections made in materials with a low elastic limit, such as aluminium, is particularly critical.

[0011] . All this inevitably limits the choice both of the materials and of the range of sections which can be bent.

[0012] . Against the operating limits of the traditional bending processes, there is however an increased demand for bent sections with a reduced bending radius and low deformation tolerances.

[0013] . The limits of the traditional bending process have so far proven insurmountable and have, in many cases, led to extremely expensive and labour-intensive alternative operating solutions being used, such as step-cutting joining.

Presentation of the invention

[0014] . Consequently, the aim of the present invention is to eliminate the problems of the prior art described above, providing a method and a bending assembly for metal sections, enabling reduction of the bending radii to obtain high quality final products in terms of dimensional tolerance and deformation.

[0015] . A further purpose of the present invention is to provide a method and a bending assembly for metal sections, which allows the use of machinery already used in the traditional method.

Brief description of the drawings

[0016] . The technical features of the invention, according to the aforesaid purposes are evident from the content of the following claims and the advantages of the same will be made clearer in the detailed description which follows made with reference to the attached drawings representing, by way of a non-limiting example, one or more embodiments wherein:

[0017] . - Figure 1a shows a flow diagram of the operating steps of the bending method according to a general embodiment of the invention;

[0018] . - Figure 1b shows a flow diagram of the operating steps of the bending method according to a preferred embodiment of the invention;

[0019] . - Figure 2 shows in perspective an open end of a container element inside of which a section to be bent has been placed upon completion of the insertion and blocking step;

[0020] . - Figure 3 shows in perspective an open end of a bending assembly, closed by a removable closing element, upon completion of an operating step of filling the container element;

[0021] . - Figure 4 shows a cross-sectional view of the assembly illustrated in Figure 3, according to the cross-section plane IV - IV therein indicated;

[0022] . - Figure 5 shows the bending step of the bending assembly illustrated in Figures 3 and 4;

[0023] . - Figure 6 shows a perspective view of a container element used in the method and in the assembly according to the invention according to a preferred embodiment; and

[0024] . - Figure 7 shows a perspective view of a bending assembly at the end of the bending step. Detailed description

[0025] . The method of bending metal sections according to the invention may, advantageously, be applied to any type of section, with an open or closed cross-section, made in any material, in particular stainless steel, iron, brass, aluminium.

[0026] . The method according to the invention allows to produce high quality bent sections (in terms of precision and dimensional tolerance) with smaller bending radii than those obtained using traditional bending methods.

[0027] . In particular, the method according to the invention allows to improve the bending quality (both in terms of precision and of reduction of the bending radius) even with sections having an open cross-section, made in materials with a low elastic limit such as aluminium, considerably reducing the risk of collapse.

[0028] . The bending method according to the invention involves bending the metal section inside a specific container element.

[0029] . The inner volume of such container element not occupied by the section is completely filled with molten filler material, left to solidify. As will be explained further below, such material must have a low melting point, below that of the material the section is made of.

[0030] . Operatively, the mechanical strain of bending is thus imposed directly on the container and transmitted indirectly to the inner section by the solidified filler material. This way the deformation forces are absorbed mainly by the container element and evenly distributed over the section to be bent by the filler material. The filler material, by completely encompassing the section, also promotes the stress relieving of the surface material of the section itself during bending.

[0031] . In particular, unlike the traditional bending method (which envisages operating directly on the section to be bent), due to the presence of the container element and to the filler material, both the compression forces generated on the inner surface of the section and the drawing forces generated on the outer surface of the section are distributed over a larger area.

[0032] . Using the method according to the invention, as well as reducing the risk of collapse of the section as a result of exceeding the elasto-plastic limit, it is possible to avoid bulge formation and bossing on the section.

[0033] . When the bending of the bending assembly comprising the container element, the filler material and the section is terminated, the filler material is discharged from the container element, e.g. after liquefaction. The container is then cut and the bent section extracted.

[0034] . In the attached drawings, reference numeral 1 globally denotes the container element, while P indicates the section to be bent. F is the sign for the filler material.

[0035] . Further on in the description, the expression "bending direction" is understood to mean the main direction of application of the sum of the deformation forces referred to the portion of container/section subjected to bending.

[0036] . In the case of bending linear type tubular sections, the plane which the overall bending line imposed on the linear element lies in (as shown in Figure 7) is known as the "bending plane PC". The bending direction C also lies on such plane.

[0037] . According to a general invention embodiment, illustrated in the diagram in Figure 1a, the method of bending metal sections according to the invention comprises the following operating steps:

[0038] . a) providing a metal container element 10 suitable for containing a chosen metal section P to be bent; to such end at least a first end 11 of the container element 10 is open to allow the insertion of the section P inside it;

[0039] . b) inserting the metal section P completely inside the container element 10, blocking the section P in position;

[0040] . c) filling the inner volume of the container element 10 left free by the section P with a molten filler F having a lower melting temperature than the softening temperature of the material of the section P;

[0041] . d) solidifying the molten filler material F inside the container element 10;

[0042] . e) subjecting the container element 10 - with the section P blocked inside it and fully encompassed in the solidified filler material F - to mechanical bending to obtain the desired bending radius R;

[0043] . f) liquefying the filler material F;

[0044] . g) emptying the container element 10 of the liquefied filler material F; and

[0045] . h) cutting the bent container element 10 to extract the bent section P from it.

[0046] . More in detail, in the aforesaid preparation step (a) the length L of the container element 10 is chosen depending on the desired bending radius R.

[0047] . In the aforesaid providing step (a) the transversal cross-section of the container element 10 is also chosen so as to permit insertion of the section P inside it.

[0048] . Preferably, the transversal cross-section of the container element is chosen depending on the transversal cross-section of the section P to be bent, so that the section P can be blocked inside the container element 10 while distanced from the inner walls of the container element 10 in the bending direction C, as shown in Figures 2 and 4.

[0049] . Even more preferably, the container element 10 is chosen so that the ratio of the cross-section of the section to be bent and the cross-section of the unoccupied container, i.e. free of the section (i.e. the cross-section between the inner walls of the container and the outer walls of the section) is between 0,8 to 1,2 and preferably 1.

[0050] . As will be described further below, it is in fact preferable for the container 10 not to come into direct contact with the section P along the bending direction C.

In such situation mechanical strain could be concentrated on some points of the section such as to cause local yielding or uncontrolled deformation.

[0051] . According to a preferred embodiment shown in the attached figures, the container element 10 has a linear extension and a closed transversal cross-section. This simplifies the bending in that the closed cross-section gives the container element 10 a greater mechanical resistance to collapse than a container with an open cross-section.

[0052] . However tubular sections with an open cross-section may be used, such as C-sections. In this case however the choice should be limited to sections which once closed at the ends present a support position in which they can act as containers. Operatively, the container element 10 must in fact be suitable for containing the filler material F in the molten state.

[0053] . Preferably, the container element 10 has a rectangular or square cross-section. This makes use of the containers simpler and easier, especially during the step of filling and solidification of the filler material F, in that they present firmer support surfaces.

[0054] . As already mentioned above, the container element 10 is open at a first end 11 to allow insertion of the section P, as well as to facilitate emptying of the liquefied filler material F.

[0055] . To such end, the container element 10 is provided with a first removable closing element 21 for such first end 11, as shown in Figure 6.

[0056] . According to the preferred embodiment shown in particular in Figure 6, the container element 10 is also open at the second end 12, opposite the first, and has a second removable closing element 22.

[0057] . Preferably, the aforesaid removable closing elements 21 and 22 are composed of a plate destined to engage inside the container element 10 with interference.

[0058] . Other types of closing elements may however be envisaged, such as partitions sliding inside guides performed on the container element 10, or plugs suitable for joining to the end of the container externally by interference.

[0059] . Preferably, as shown in Figure 6 the container element 10 has at least one aperture 30 for casting the molten filler material F inside it.

[0060] . Advantageously, along the longitudinal extension of the container 10 there may however also be several casting apertures 30 to allow faster and easier filling of the container element 10.

[0061] . According to a preferred embodiment of the invention shown in the diagram of Figure 1b, the method comprises a step of shaking (i) the container element 10. Such step is to be conducted at the same time or subsequent to the filling step (e), before solidification of the filler material F. Such step has the purpose of encouraging any bubbles of air trapped inside the mass of molten material F following its casting inside the container element 10 to come out.

[0062] . Advantageously, to facilitate the release of the air present inside the container element and any air bubble trapped in the molten filler material F, the container element 10 may be provided with a multiplicity of vent holes 31 distributed along its longitudinal extension.

[0063] . As shown in Figure 6, such vent holes 31 are made on the same wall which the aforesaid casting aperture 30 is made on, to prevent leakage of the molten filler material F during the filling step.

[0064] . As already mentioned, the section P, once inserted, is blocked in position inside the container element 10 so as to be distanced from the inner walls of the container along the bending direction C.

[0065] . Advantageously, as shown in Figures 2 and 4, the section P is blocked in position inside the container element 10, leaning against at least one wall 14 of the container element 10. As will be described further below, this makes blocking of the section P to the inside of the container element 10 more stable.

[0066] . Preferably, such support wall 14 of the container element extends on a plane parallel to the bending plane PC. In fact, this way direct transmission of the strain from the container 10 to the section P along the bending direction C and thereby harmful strain concentrated on the section P is prevented.

[0067] . Operatively, the section P is blocked inside the container element 10 by removable blocking means 40 which the container element 10 is provided with.

[0068] . Preferably, such blocking means 40 are suitable for acting on the section P in directions different to the bending direction C, so as to prevent the deformation strain from being transmitted locally in a concentrated manner onto the section P.

[0069] . According to the embodiment shown in Figures 2 and 4, such blocking means 40 act in a direction substantially orthogonal to said bending direction C, so as to keep the section P firmly pressed against the inner support wall 14 of the container 10.

[0070] . According to a preferred embodiment shown in Figures 2, 4 and 6, the aforesaid blocking means comprise a multiplicity of threaded rods 40 inserted in corresponding counter-threaded holes 41 distributed along the longitudinal extension of the container element 10 and destined to abut against the section P.

[0071] . Preferably, such holes 41 are made on the same wall which the aforesaid casting aperture 30 is made on.

[0072] . As already mentioned, the function of the filler material F, which the inner space of the container element 10 left free by the section P is filled with, is to transmit the mechanical strain evenly to the section and, by encompassing it entirely, to encourage the stress relieving of the surface material of the section P during bending.

[0073] . Operatively, in order to completely fill the container 10 and encompass the section P in all the tiny interstices the material F must be in a liquid state.

[0074] . To prevent heat damage and deformation of the section P, such material must have a lower melting point than the material of the section P.

[0075] . From an operative point of view, it is preferable for the filler material to have a melting temperature of less than 100°C. In such case the liquefaction of the filler material F can be performed in a tank of boiling water. This makes both the preparation step of the material for filling the container, and the liquefying step of the material for emptying the container element 10 after bending easier and more convenient from an operative point of view.

[0076] . Preferably, regardless of the material forming the section P (steel, brass, iron, aluminium) the filler material F is chosen so as to have mechanical properties similar to those of aluminium.

[0077] . It has, in fact, been observed that this way the discontinuities in the interface area between the mass of filler material F and the section P are reduced to a minimum. This allows the material F on the one hand to evenly distribute the strain, and on the other to encourage stress relieving of the surface material of the section P during bending.

[0078] . Advantageously, the filler material F is a metal alloy.

[0079] . According to a preferred embodiment of the invention, the filler material F is a metal alloy comprising lead (Pb), cadmium (Cd) and/or its derivatives, tin (Sn) e bismuth (Bi).

[0080] . The use of an alloy composed of 26,7% in weight of lead, 10,0%wt of cadmium, 50%wt of bismuth and 13,30%wt of tin is particularly preferred. For example the alloy known as LegF73C made by OMODEO AES METALLEGHE Srl may be used.

[0081] . This alloy has a relative density of about 9,38 g/cm^3, a melting temperature of 70-80°C and a boiling temperature of over 1500°C. The alloy is insoluble in water.

[0082] . More specifically, using the aforesaid alloy 50 Bi, 26,7 Pb, 13,3 Sn and 10,0 Cd, the solidification of the filler material F inside the container can be conducted by immersing the container 10 in a tank of water at 12°C for a period of time of about 2 hours, while its liquefaction can be achieved by immersing it in a tank of water at 90°C for a period of time of about one and a half hours.

[0083] . Preferably, this alloy is used for bending aluminium sections as it has similar mechanical properties. It can however also be advantageously used to bend sections not in aluminium, for example in iron, stainless steel and brass.

[0084] . The bending step may be performed using any device suitable for the purpose, preferably by hydraulic bending machines N with calender rollers Q (as shown in Figure 5) provided with dies M to fit on said rollers.

[0085] . Unlike the traditional bending method, it is no longer necessary to make dies to measure for each section to be bent. According to the invention, the dies operate in fact on the container 10 and no longer on the section P to be bent. It is therefore sufficient to have a limited set of dies M for the types of tubular sections normally used.

[0086] . Advantageously, at the end of the bending step (e) a control step of the achieved bending radius may be foreseen. If necessary, attempts may be made to correct any imperfections using the bending machine.

[0087] . The cutting of the container element 10 at the end of bending may be performed using any suitable instrument for the purpose, in particular using disc milling machines or cutting machines.

[0088] . As shown in the diagram in Figure 1b, the method comprises a cleaning step (l) of the section to be performed on the bent section P extracted from the container element 10. Using the metal alloy specified above as filler, cleaning can be performed by immersing in boiling water and applying a slight surface friction to the section.

[0089] . Once extracted, the bent section P is subjected to quality control, in terms of bending radius, dimensional tolerance and any defect.

[0090] . The method according to the present invention, brings many advantages, some of which already mentioned.

[0091] . The method according to the invention allows to bend any type of section, with an open or closed cross-section, without any limitation on the type of material.

[0092] . In particular, sections made in material with a low elastic limit, such as aluminium, can be bent more easily and with better results.

[0093] . Compared to the traditional method, for the same section to be bent, the bending radius can be considerably reduced without affecting the final quality of the product.

[0094] . To better emphasise the advantages of the present invention, comparison is e.g. made between traditional bending and bending according to the invention applied to a "U"-section in aluminium of 120 mm (width) x 45 mm (height) x 6 metres (length); thickness of the wall of the "U" is 4 mm.

[0095] . Using the traditional bending method, a U section in aluminium with the aforesaid features cannot be bent to a bending radius of less than 3.000 mm, assuming bending to be imposed on the side with the biggest cross-section. Below such radius the section loses its bendability features, with anomalous deformation and collapse of the central core. Diversely, using the method according to the invention, the same U-section can be bent to a radius of down to 1.500 mm, without generating uncontrolled deformations or collapse.

[0096] . The method according to the invention prevents deformations of the cross-section of the section. The sections bent using the method according to the invention can thus be more easily coupled at their ends with linear elements having the same transversal cross-section.

[0097] . Thanks to the stress relieving effect of the filler material on the surface portions of the section P, the bulging and bossing formation related to concentrated, localised strain can be avoided.

[0098] . The method according to the invention also permits the bending of sections which have already been painted. In fact, unlike the traditional method, the sections to be bent are no longer subjected to rubbing by the dies of the bending machines. Any surface coating or cladding is therefore not subject to damage during the bending step.

[0099] . It is therefore essential that the method of bending metal sections according to the invention comprises the operating steps of providing a container element 10, e.g. tubular or box-shaped, having a wall 14 identifying a container cavity suitable for at least partially housing a section P to be bent in at least one bending plane PC, inserting the section P in the container cavity, filling the container cavity at least with a filler material F and subjecting the container element 10 to bending, e.g. roller-bending, until the desired bending radius R is achieved.

[0100] . According to one advantageous variation of the invention, the filling step comprises a step of also filling a section cavity, identified by the section P.

[0101] . It is also essential that the bending assembly comprises a section P to be bent in at least one bending plane PC, a container element 10, e.g. tubular or box-shaped, having a wall 14 identifying a container cavity in which the section P is at least partially housed, and a filler material F filling at least the container cavity.

[0102] . According to a preferred embodiment of the assembly, the section P identifies at least one section cavity, filled by the filler material F.

[0103] . The invention thus conceived thereby achieves the predetermined objectives.

[0104] . Obviously, it may, in its practical embodiment, assume forms and configurations different from those shown, while remaining within the present scope of protection.

[0105] . In addition, all the parts may be replaced by technically equivalent parts and the sizes, shapes and materials used may be chosen as needed.

Claims

1. Method for bending metal sections, comprising the following operating steps:

a) providing a container element (10), e.g. tubular or open box-shaped, having a wall (14) identifying a container cavity suitable for at least partially housing a section (P) to be bent in at least one bending plane (PC);
wherein said section (P) identifies at least one section cavity;
b) inserting the section (P) in the container cavity;
c) filling at least the container cavity and section cavity with a filler material (F);
d) subjecting to bending, e.g. roller-bending, the container element (10) until a desired bending radius (R) is achieved.

2. Method according to claim 1, wherein the step of filling the container cavity and the section cavity comprises a step of pouring in a filler material (F) suitable for solidifying or reticulating.

3. Method according to claim 2, further comprising a step of solidifying or reticulating the filler material (F).

4. Method according to any of the previous claims, further comprising a step of extracting the section (P) from the container cavity, said step of extracting comprising a step of cutting the wall (14) of the container element (10).

5. Method according to any of the previous claims, wherein the step of inserting is followed by a step of blocking the section (P) in the container cavity, e.g. in abutment against the wall (14) of the container element (10).

6. Method according to any of the previous claims, further comprising a step of shaking the container element (10) so as to allow an even distribution of the filler material (F) in the container cavity and/or section cavity, and/or to promote the release of any air bubble.

7. Bending assembly comprising:

- a section (P) to be bent in at least one bending plane (PC) and identifying at least one section cavity;
- a container element (10), e.g. tubular or open box-shaped, having a wall (14) identifying a container cavity wherein the section (P) is at least partially housed; and
- a filler material (F) filling at least the container cavity and the section cavity.

8. Assembly according to claim 7, wherein the ratio between the cross-section of the section (P) and the cross-section of the container element (10) free of the section (P) is 0,8 to 1,2 and, preferably, substantially equal to 1.

9. Assembly according to claims 7 or 8, wherein at least one extremity (11, 12) of the container element is open to enable the insertion of the section (P).

10. Assembly according to claim 9, further comprising a closing element (21, 22) joinable to the extremity (11, 12) so as to overlay at least partially the opening of the latter.

11. Assembly according to any of the claims from 7 to 10, wherein the container element (10) has at least one casting opening (30) to enable filling of the container cavity and/or section cavity.

12. Assembly according to any of the claims from 7 to 11, wherein the container wall is provided with at least one vent hole (31) to promote the release of any air bubble contained in the filler material (F).

13. Assembly according to any of the claims from 7 to 12, wherein the filler material (F) is suitable for solidifying or reticulating.

14. Assembly according to claim 13, wherein the filler material (F) is a metal alloy, e.g. comprising lead, cadmium, bismuth and tin, preferably having a melting temperature lower than that of the material of the section (P).

15. Assembly according to any of the claims from 7 to 14, further comprising blocking means (40) for the removable blocking of the section (P) to the container element (10), e.g. comprising at least one threaded rod (40) extending from the wall (14) of the container element (10) and movable so as to abut against the section (P).

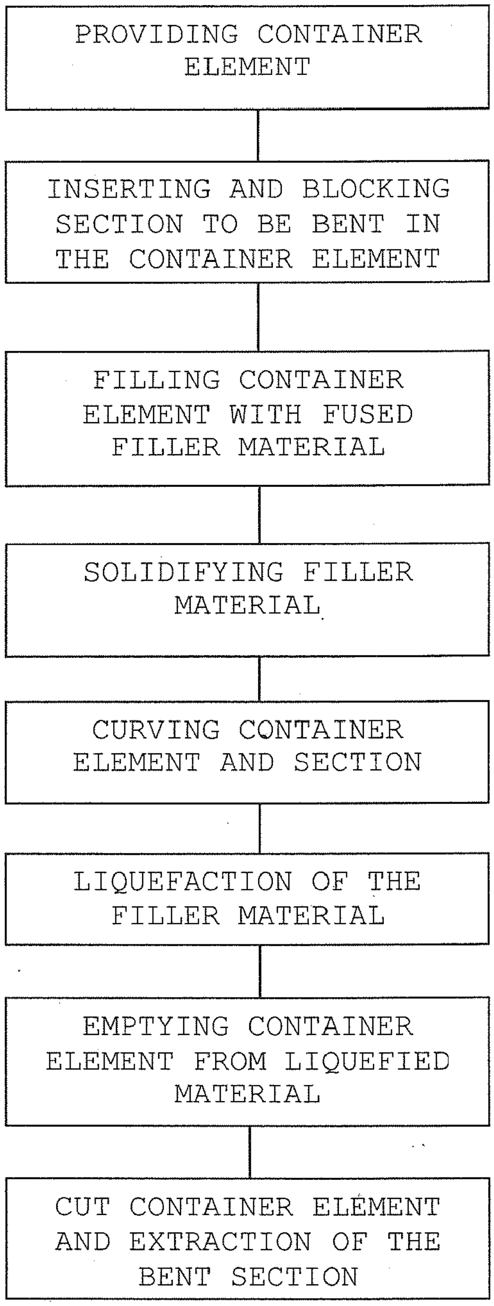

PROVIDING CONTAINER ELEMENT
INSERTING AND BLOCKING SECTION TO BE BENT IN THE CONTAINER ELEMENT
FILLING CONTAINER ELEMENT WITH FUSED FILLER MATERIAL
SOLIDIFYING FILLER MATERIAL
CURVING CONTAINER ELEMENT AND SECTION
LIQUEFACTION OF THE FILLER MATERIAL
EMPTYING CONTAINER ELEMENT FROM LIQUEFIED MATERIAL
CUT CONTAINER ELEMENT AND EXTRACTION OF THE BENT SECTION

Fig. 1a

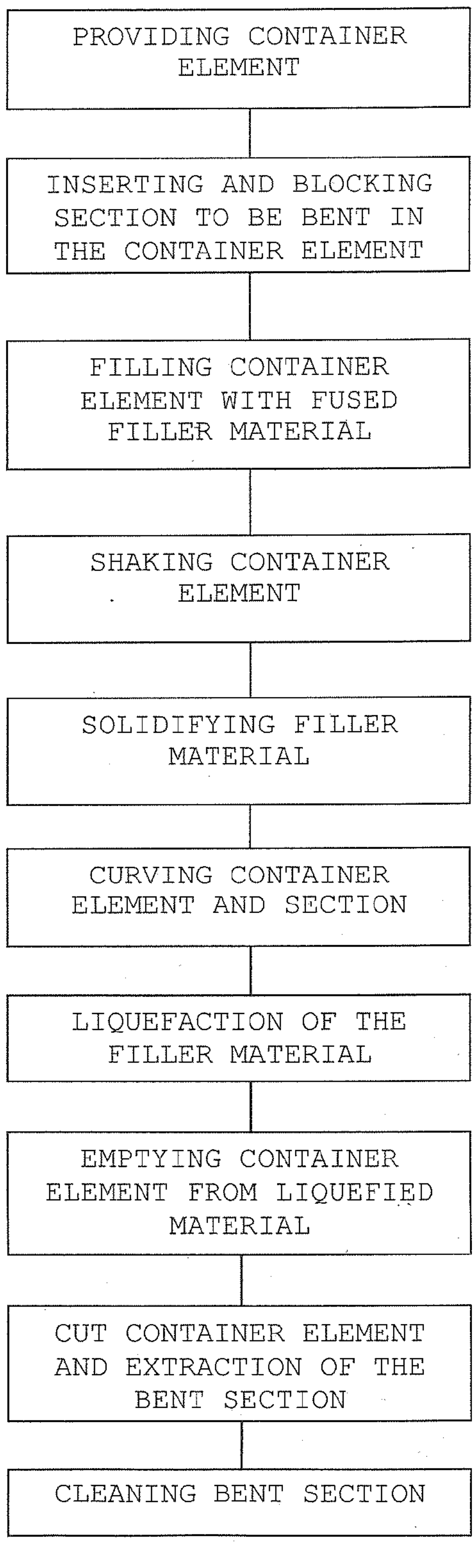

PROVIDING CONTAINER ELEMENT
INSERTING AND BLOCKING SECTION TO BE BENT IN THE CONTAINER ELEMENT
FILLING CONTAINER ELEMENT WITH FUSED FILLER MATERIAL
SHAKING CONTAINER ELEMENT
SOLIDIFYING FILLER MATERIAL
CURVING CONTAINER ELEMENT AND SECTION
LIQUEFACTION OF THE FILLER MATERIAL
EMPTYING CONTAINER ELEMENT FROM LIQUEFIED MATERIAL
CUT CONTAINER ELEMENT AND EXTRACTION OF THE BENT SECTION
CLEANING BENT SECTION

Fig.1b

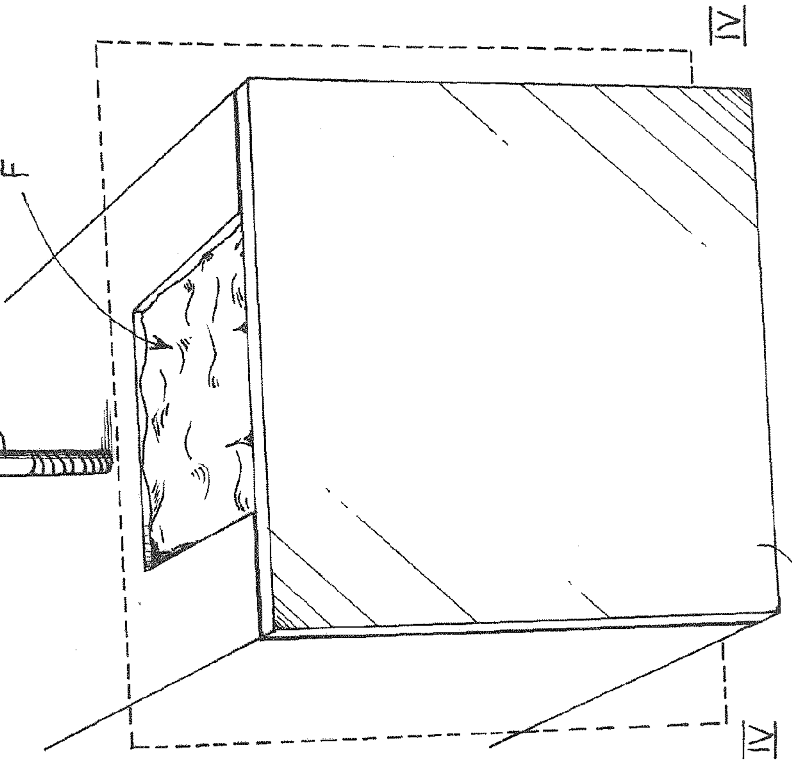


Fig. 3

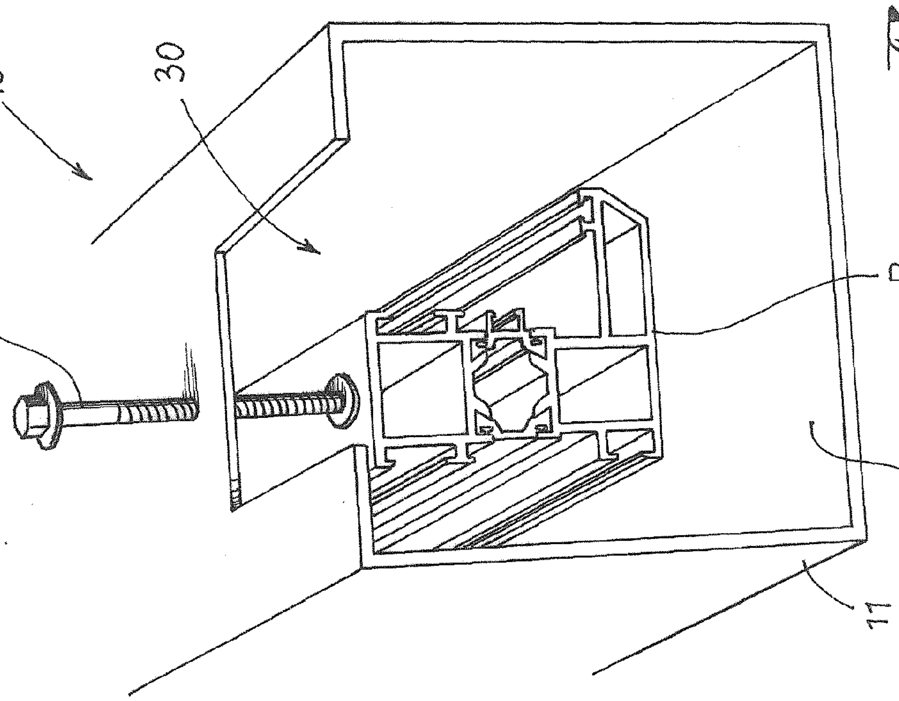


Fig. 2

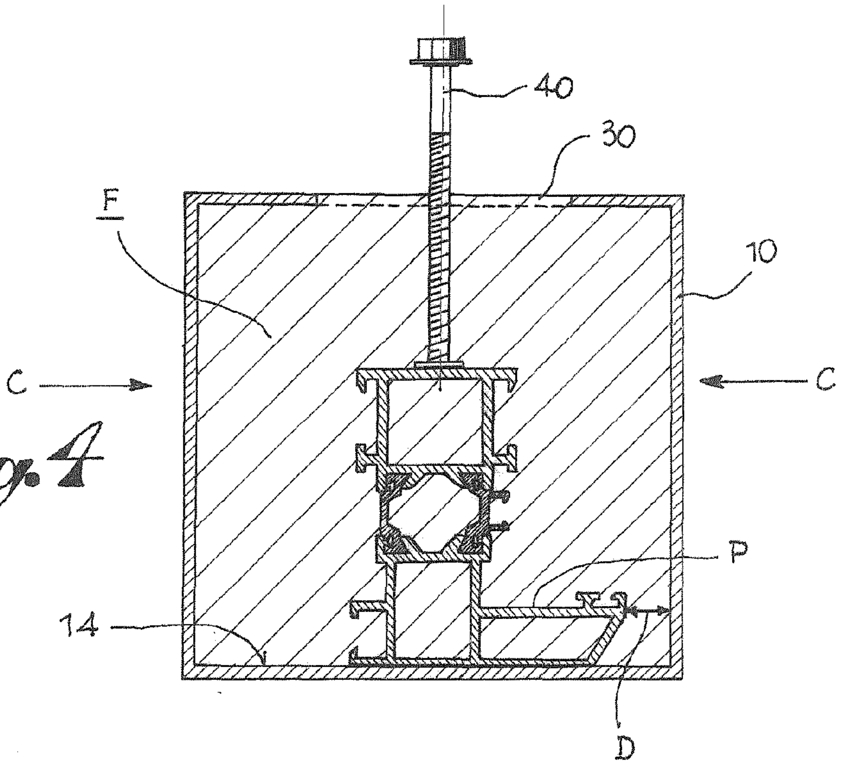


Fig. 4

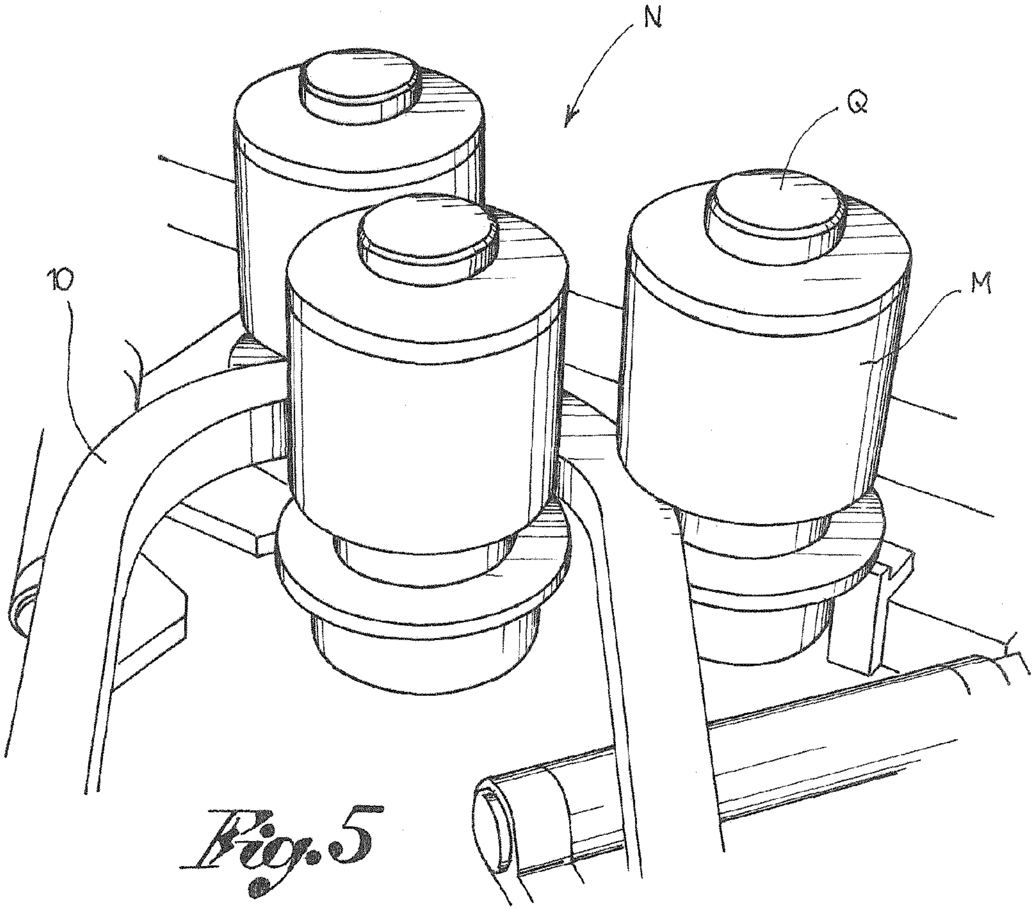


Fig. 5

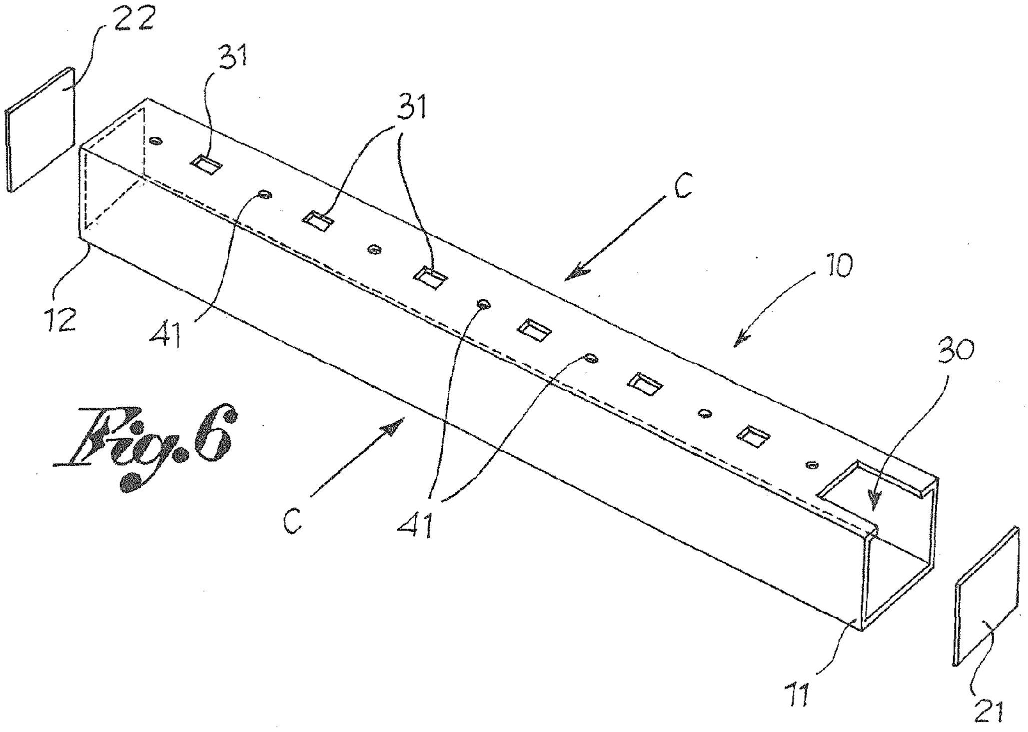
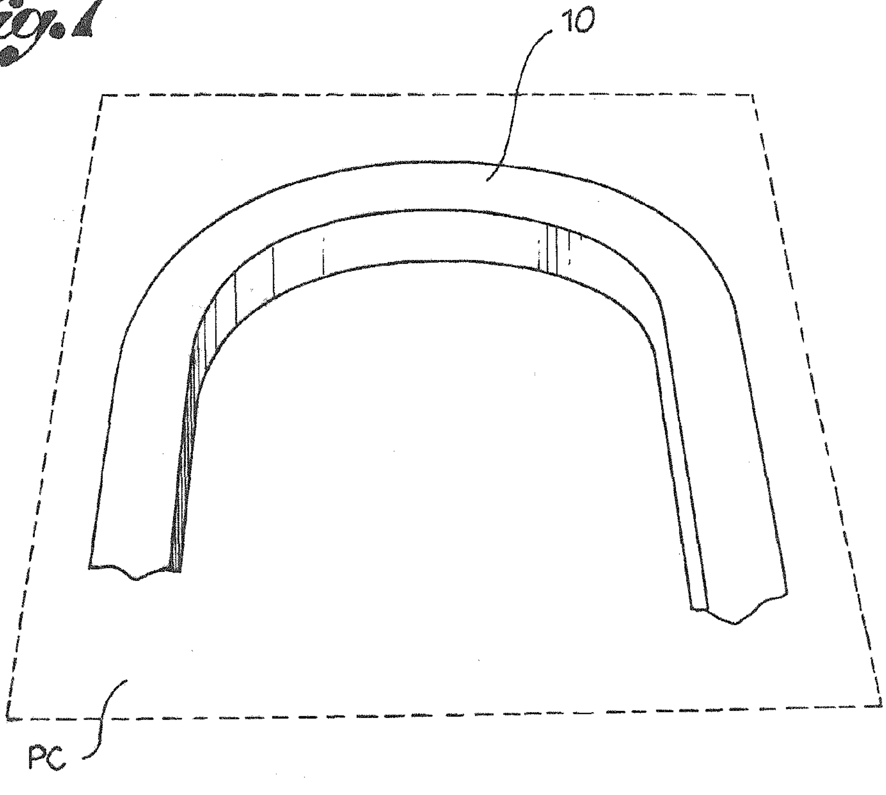


Fig.6

Fig.7



Europäisches Patentamt
European Patent Office
Office européen des brevets

EUROPEAN SEARCH REPORT

Application Number
EP 10 16 1942

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
X	FR 2 677 564 A (SANCHEZ JEAN [FR]) 18 December 1992 (1992-12-18) * the whole document * -----	1-15	INV. B21D9/15
X	US 5 907 896 A (TSENG SHAO-CHIEN [TW]) 1 June 1999 (1999-06-01) * the whole document * -----	1-15	
X	JP 60 064733 A (SUZUKI MOTOR CO) 13 April 1985 (1985-04-13) * abstract; figures * -----	1-15	

TECHNICAL FIELDS SEARCHED (IPC)
B21D

The present search report has been drawn up for all claims

1

Place of search	Date of completion of the search	Examiner
Munich	26 July 2010	Knecht, Frank

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
Y : particularly relevant if combined with another document of the same category
A : technological background
O : non-written disclosure
P : intermediate document

T : theory or principle underlying the invention
E : earlier patent document, but published on, or after the filing date
D : document cited in the application
L : document cited for other reasons
....
& : member of the same patent family, corresponding document

EPO FORM 1503 03.82 (P04C01)

ANNEX TO THE EUROPEAN SEARCH REPORT ON EUROPEAN PATENT APPLICATION NO. EP 10 16 1942

This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report.
The members are as contained in the European Patent Office EDP file on
The European Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

26-07-2010

Patent document cited in search report		Publication date	Patent family member(s)	Publication date
FR 2677564	A	18-12-1992	NONE	
US 5907896	A	01-06-1999	US 5974854 A	02-11-1999
JP 60064733	A	13-04-1985	NONE	

EPO FORM P0459

For more details about this annex : see Official Journal of the European Patent Office, No. 12/82