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(54) **METHOD FOR MANUFACTURING L-SHAPED SQUARE PIPE, DEVICE FOR MANUFACTURING L-SHAPED SQUARE PIPE, AND L-SHAPED SQUARE PIPE**

(57) Provided is a method for manufacturing an L-shaped square pipe that ensures adequate strength even without welding, a device for manufacturing the L-shaped square pipe, and the L-shaped square pipe. Provided is a method for manufacturing an L-shaped square pipe 1A, comprising: a groove section forming step for forming a groove section 5 by pressing one sur-

face 1a of a square steel pipe 1, along the shorter direction of the one surface 1a, towards another surface 1b positioned on the reverse side of the one surface 1a; and a bending step for bending the square pipe so that the sides of the first surface 1a sandwiching the groove section 5 approach each other.

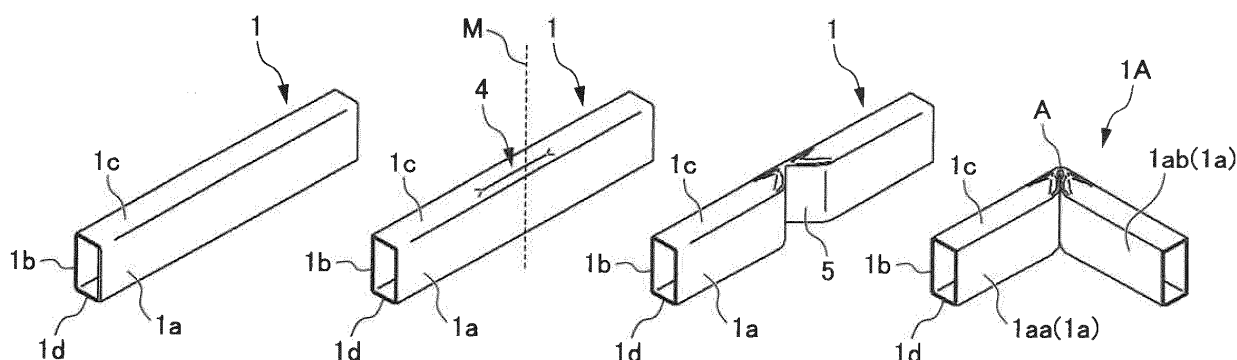


FIG. 1A

FIG. 1B

FIG. 1C

FIG. 1D

Description

TECHNICAL FIELD

[0001] The present invention relates to a method for manufacturing an L-shaped square pipe, a device for manufacturing an L-shaped square pipe and an L-shaped square pipe.

BACKGROUND ART

[0002] Conventionally, an L-shaped square steel pipe is used as a structural member which forms a frame for a unit bath platform or a structural member which is used as a partition wall for attaching an exterior wall panel for a prefabricated house to a beam or the like.

[0003] As a method for manufacturing an L-shaped square steel pipe, a method is used in which in a state where an end portion of one of two square steel pipes is pressed to the side surface of an end portion of the other square steel pipe, they are welded together, and in which thus the square steel pipes are fixed.

[0004] However, in this method, in order to obtain sufficient joining strength, it is necessary to weld the entire periphery of the end portion of the square steel pipe. When the accuracy of cutting of the end portion of the square steel pipe and the accuracy of locating thereof are low, the necessary strength may not be obtained even by welding. When welding is performed, the dimensional accuracy may be lowered by the occurrence of a warp or a twist caused by thermal distortion. In the welding, there is also a problem in which an operational environment is degraded by the production of fumes. With consideration given to specifications of the appearance and corrosion resistance, finishing or repair is needed for the welded portion.

[0005] A technology is also proposed in which V-shaped cutouts are formed in the upper surface and both side surfaces of square steel pipes and bending is performed, and in which both side surfaces abutting on each other are thereafter welded and manufacturing is performed (see Patent Document 1).

[0006] Patent Document 1: Japanese Unexamined Patent Application, Publication No. 2010-201503

DISCLOSURE OF THE INVENTION

Problems to be Solved by the Invention

[0007] However, in the conventional technology described above, the V-shaped cutouts are formed in the upper surface and both side surfaces of the square steel pipe, and thus among the four surfaces of the square steel pipe, only one surface which is the bottom surface is not cut out. Hence, in the cutout portions in the square steel pipe, the strength thereof is significantly lowered as compared with the other portions. In order to compensate for the decrease in strength, it is necessary to weld the

portions in which the cutouts are made to abut on each other.

[0008] Then, as described above, the dimensional accuracy may be lowered by the occurrence of a warp or a twist caused by thermal distortion. In the welding, there is also a problem in which an operational environment is degraded by the production of fumes.

[0009] An object of the present invention is to provide a method for manufacturing an L-shaped square pipe whose sufficient strength is acquired without performing welding, a device for manufacturing an L-shaped square pipe and an L-shaped square pipe.

Means for Solving the Problems

[0010] According to one aspect of the present invention, there is provided a method for manufacturing an L-shaped square pipe, the method including: a groove section forming step for forming a groove section by pressing one surface of a square pipe along a shorter direction of the one surface to the side of the other surface located on a reverse side of the one surface; and a bending step for bending the square pipe such that both sides of the one surface sandwiching the groove section approach each other.

[0011] Preferably, in the groove section forming step, the groove section is formed by pressing, to the one surface, a corner portion of a V-shaped portion in a pressing member having the V-shaped portion.

[0012] Preferably, the angle of the corner portion of the V-shaped portion corresponds to a bending angle of the square pipe.

[0013] Preferably, the method further includes, before the groove section forming step, a buckling line forming step for forming buckling lines by pressing two side surfaces between the one surface of the square pipe and the other surface inward along a longitudinal direction of the side surfaces.

[0014] According to another aspect of the present invention, there is provided a device for manufacturing an L-shaped square pipe, the device including: a groove section forming device for forming a groove section by pressing one surface of a square pipe along a shorter direction of the one surface to the side of the other surface located on a reverse side of the one surface; and a bending device for bending the square pipe such that both sides of the one surface sandwiching the groove section approach each other.

[0015] The present invention is an L-shaped square pipe, in which a square pipe is bent through a groove section provided along a shorter direction of one surface thereof.

Effects of the Invention

[0016] According to the present invention, it is possible to provide a method for manufacturing an L-shaped square pipe whose sufficient strength is acquired without

performing welding, a device for manufacturing an L-shaped square pipe and an L-shaped square pipe.

BRIEF DESCRIPTION OF THE DRAWINGS

[0017]

Fig. 1A is a diagram illustrating a method for manufacturing an L-shaped square steel pipe in which the L-shaped square steel pipe is manufactured by bending a square steel pipe;

Fig. 1B is a diagram illustrating a method for manufacturing an L-shaped square steel pipe in which the L-shaped square steel pipe is manufactured by bending a square steel pipe;

Fig. 1C is a diagram illustrating a method for manufacturing an L-shaped square steel pipe in which the L-shaped square steel pipe is manufactured by bending a square steel pipe;

Fig. 1D is a diagram illustrating a method for manufacturing an L-shaped square steel pipe in which the L-shaped square steel pipe is manufactured by bending a square steel pipe;

Fig. 2 is a schematic view of a buckling line forming device for realizing a buckling line forming step;

Fig. 3 is a schematic view of a groove section forming device for realizing a groove section forming step;

Fig. 4A is a schematic view of a bending device for realizing a bending step;

Fig. 4B is a schematic view of a bending device for realizing a bending step;

Fig. 5 is a photograph of the square steel pipe in a state where a groove section is formed by the groove section forming step in the manufacturing method according to the present embodiment;

Fig. 6 is a photograph of a bent portion of the L-shaped square steel pipe which has been bent by the bending step in the manufacturing method according to the present embodiment; and

Fig. 7A is a diagram showing examples of the application of the method for bending the square steel pipe according to the present embodiment, and showing a square steel pipe having two bent portions.

Fig. 7B is a diagram showing examples of the application of the method for bending the square steel pipe according to the present embodiment, and showing a rectangular square steel pipe having three bent portions.

PREFERRED MODE FOR CARRYING OUT THE INVENTION

[0018] A method for manufacturing an L-shaped square steel pipe 1A according to an embodiment of the present invention will be described below. Figs. 1A to 1D are diagrams illustrating the method for manufacturing the L-shaped square steel pipe 1A according to the

present embodiment.

[0019] In the method for manufacturing the L-shaped square steel pipe 1A, one surface 1a of a square steel pipe 1 which is extended linearly as shown in Fig. 1A is pressed along the shorter direction of the one surface 1a to the side of the other surface 1b located on the reverse side of the one surface 1a. In this way, as shown in Fig. 1C, a groove section 5 is formed. Then, the square steel pipe 1 is bent, and thus the L-shaped square steel pipe 1A having a bent portion A as shown in Fig. 1D is manufactured.

[0020] The square steel pipe 1 which is bent in the shape of the letter L in the present embodiment is a hollow square pipe whose cross section is rectangular and which is made of steel. However, in the present embodiment, the square pipe is not limited to steel, and any other material may be used as long as it is a material which can be plastically deformed by being bent.

[0021] Although in the present embodiment, a case where the cross section of the square steel pipe 1 is rectangular will be described, the cross section may be square. However, preferably, the cross section of the square steel pipe 1 is rectangular, and the width of the one surface 1a and the other surface 1b in the shorter direction is greater than the width of side surfaces 1c and 1d in the shorter direction.

[0022] In the following description, the method for manufacturing the L-shaped square steel pipe 1A having the bent portion A which is bent at a right angle (90°) will be described. However, the angle at which the bent portion A is bent is not limited to a right angle, and the angle may be an acute angle or an obtuse angle.

[0023] As shown in Fig. 1, the method for manufacturing the L-shaped square steel pipe 1A according to the present embodiment includes: a buckling line forming step (Fig. 1B) for providing a buckling line 4 by pressing the side surfaces 1c and 1d of the square steel pipe 1 shown in Fig. 1A; a groove section forming step (Fig. 1C) for forming the groove section 5 by pressing the one surface 1a of the square steel pipe 1; and a bending step (Fig. 1D) for bending the square steel pipe 1.

[0024] The method for manufacturing the L-shaped square steel pipe 1A is performed by a manufacturing device 100 for an L-shaped square pipe which includes a buckling line forming device 2, a groove section forming device 3 and a bending device 15 which will be described later. However, the method for manufacturing the L-shaped square steel pipe 1A according to the present embodiment is not limited to the use of the manufacturing device 100.

(Buckling line forming step)

[0025] As shown in Fig. 1B, the buckling line forming step is a step for forming the buckling lines 4 in the side surfaces 1c and 1d by pressing the side surfaces 1c and 1d of the square steel pipe 1.

[0026] An example of the buckling line forming device

2 for realizing the buckling line forming step is shown in Fig. 2. However, the device for forming the buckling lines 4 in the side surfaces 1c and 1d of the square steel pipe 1 is not limited to the buckling line forming device 2.

[0027] The buckling line forming device 2 includes two side surface pressing punches 6 having a shape in which a V-shaped portion 6a is formed in one side surface of a rectangular parallelepiped. The two side surface pressing punches 6 are arranged such that the corner portions 6b of the V-shaped portions 6a are along the longitudinal direction of the side surfaces 1c and 1d. Furthermore, the corner portions 6b of the V-shaped portions 6a are arranged in a state where they can abut on substantially central portions of the side surfaces 1c and 1d so as to sandwich the square steel pipe 1 from the sides of the side surfaces 1c and 1d.

[0028] The corner portions 6b of the V-shaped portions 6a in the two side surface pressing punches 6 are respectively made to abut on the substantially central portions of the side surfaces 1c and 1d of the square steel pipe 1 along the longitudinal direction.

[0029] In a state where the square steel pipe 1 is sandwiched between the two side surface pressing punches 6, a force is applied in a direction in which the two side surface pressing punches 6 approach each other and thus the side surfaces 1c and 1d of the square steel pipe 1 are deformed such that the centers of the side surfaces 1c and 1d are recessed inward, with the result that the buckling lines 4 along the longitudinal direction are formed.

[0030] The length of the buckling lines 4 is adjusted as necessary so as to correspond to the dimensions of the square steel pipe 1 such that in the groove section forming step described later, the portion where the buckling lines 4 are provided is easily buckled inward.

[0031] The amount of deformation (depth) of the buckling lines 4 is preferably deeper as long as the side surfaces 1c and 1d do not break.

[0032] After the formation of the buckling lines 4, the two side surface pressing punches 6 are separated from the side surfaces 1c and 1d of the square steel pipe 1.

(Groove section forming step)

[0033] As shown in Fig. 1C, the groove section forming step is a step for forming the V-shaped groove section 5 by pressing the one surface 1a of the square steel pipe 1 to the side of the other surface 1b along the shorter direction of the one surface 1a.

[0034] A specific example of the groove section forming device 3 (crushing die) for realizing the groove section forming step is shown in Fig. 3.

[0035] The groove section forming device 3 includes two side surface holding portions 7 and a groove section forming punch 8. However, the device for forming the V-shaped groove section 5 in the square steel pipe 1 by pressing the one surface 1a of the square steel pipe 1 is not limited to this device.

[0036] The side surface holding portions 7 are formed in the shape of a rectangular parallelepiped, and abut on the side surfaces 1c and 1d of the square steel pipe 1 so as to hold the square steel pipe 1. In Fig. 3, one of the two side surface holding portions 7 which overlaps the square steel pipe 1 is indicated by dotted lines.

[0037] As with the side surface pressing punch 6, the groove section forming punch 8 has a shape in which a V-shaped portion 8a is formed in one surface of the rectangular parallelepiped. The groove section forming punch 8 is arranged above the one surface 1a such that the corner portion 8b of the V-shaped portion 8a is located on a center line M in a place of the one surface 1a where the groove section is to be formed.

[0038] In the present embodiment, the angle θ of the V-shaped portion 8a is slightly larger than the bending angle of the L-shaped square steel pipe 1A (in the present embodiment, a right angle (90°)). As described above, the angle θ of the V-shaped portion 8a is set slightly larger than the bending angle of the square steel pipe 1, and thus when the square steel pipe 1 is bent in the subsequent bending step, the bending angle of the L-shaped square steel pipe 1A is a desired value (in the present embodiment, a right angle (90°)).

[0039] The corner portion 8b of the V-shaped portion 8a is preferably rounded such that in the formation of the V-shaped groove section 5, the square steel pipe 1 is prevented from being broken.

[0040] The amount of pressing of the groove section forming punch 8, that is, the depth over which the groove section forming punch 8 is pressed here is such an amount that the one surface 1a makes contact with the other surface 1b. In this way, the individual surfaces of the square steel pipe 1 are prevented from being broken.

[0041] The square steel pipe 1 is first arranged between the two side surface holding portions 7.

[0042] Then, the corner portion 8b of the V-shaped portion 8a of the groove section forming punch 8 is made to abut on the center line M.

[0043] Then, a force is applied to the groove section forming punch 8, and thus the place of the square steel pipe 1 where the groove section is to be formed is pressed to the side of the other surface 1b.

[0044] The depth over which the place is pressed here is such a depth that the one surface 1a makes contact with the other surface 1b.

[0045] In this way, as shown in Fig. 3, the one surface 1a of the square steel pipe 1 is crushed so as to be deformed, and thus the V-shaped groove section 5 is formed.

[0046] Then, after the formation of the groove section 5, the groove section forming punch 8 is separated from the one surface 1a of the square steel pipe 1.

[0047] Although in the present embodiment, the L-shaped square steel pipe 1A in which the square steel pipe 1 is bent substantially at a right angle is manufactured, there is no limitation to this configuration. The angle

of the L-shaped portion of the L-shaped square steel pipe 1A can be adjusted, and the angle of the corner portion 8b of the groove section forming punch 8 can also be adjusted so as to correspond to the angle of the L-shaped portion.

(Bending step)

[0048] As shown in Fig.1D, the bending step is a step of bending the square steel pipe 1 such that both sides (one side 1aa and the other side 1ab) sandwiching the portion of the one surface 1a where the groove section 5 is formed approach each other.

[0049] A specific example of the bending device (fold bending die) 15 for realizing the bending step is shown in Fig. 4. However, the device for bending the square steel pipe 1 is not limited to this device.

[0050] The bending device 15 includes two retaining plates 9, a top die 10, a bottom die 11, a bend die 12 and a bend punch 13.

[0051] The retaining plates 9 are plate members which retain the side surfaces 1c and 1d of the square steel pipe 1. Two retaining plates 9 are provided, the square steel pipe 1 is sandwiched therebetween and thus the side surfaces 1c and 1d are retained, with the result that the square steel pipe 1 is held so as not to move. In Fig. 4, one of the retaining plates 9 is indicated by dotted lines.

[0052] The top die 10 has substantially the same width as the square steel pipe 1, and is arranged so as to retain the one side 1aa sandwiching the portion of the one surface 1a of the square steel pipe 1 where the groove section 5 is formed.

[0053] The bottom die 11 has substantially the same width as the square steel pipe 1, and is arranged on a side opposite to the top die 10 (the side in contact with the other surface 1b of the square steel pipe 1), sandwiching the square steel pipe 1.

[0054] The bend die 12 has substantially the same width as the square steel pipe 1, and can be rotated about a rotation shaft 14 with respect to the bottom die 11.

[0055] In a state of Fig.4A before the square steel pipe 1 is bent, the bend die 12 is aligned linearly with the bottom die 11.

[0056] In a state of Fig.4B after the L-shaped square steel pipe 1A is manufactured, the bend die 12 is inclined substantially perpendicular to the bottom die 11 about the rotation shaft 14.

[0057] The bend punch 13 is formed in the shape of a rectangular parallelepiped, and is coupled to an unillustrated advance/retraction mechanism. In the state of Fig. 4A before the square steel pipe 1 is bent, one surface perpendicular to the advance/retraction direction abuts on the bend die 12.

[0058] When the bend punch 13 is moved to the side of the square steel pipe 1 by the unillustrated advance/retraction mechanism, the bend die 12 is pressed up.

[0059] Thus, the bend die 12 is rotated about the rotation shaft 14.

[0060] By the rotation, the other surface on the other side 1ab of the square steel pipe 1 sandwiching the groove section 5 is pressed up.

[0061] In this way, the other side 1ab of the square steel pipe 1 is rotated, and thus the side of the one surface 1a on the other side 1ab abuts on the side surface of the top die 10. The surface of the bend punch 13 parallel to the advance/retraction direction abuts on the bend die 12.

[0062] The amount of pressing up of the bend punch 13 is adjusted, and thus it is possible to adjust the bending angle of the L-shaped bent portion A in the L-shaped square steel pipe 1A. For example, in the state of Fig. 4B, the bend punch 13 is most pressed up, and thus the L-shaped square steel pipe 1A is bent at 90°.

[0063] Fig. 5 is a photograph of the square steel pipe 1 in a state where the groove section 5 is formed by the groove section forming step in the manufacturing method according to the present embodiment. Fig. 6 is a photograph of the bent portion A of the L-shaped square steel pipe 1A which has been bent by the bending step in the manufacturing method according to the present embodiment.

[0064] As described above, the L-shaped square steel pipe 1A manufactured in the present embodiment is formed without the four side surfaces of the square steel pipe 1 being cut out.

[0065] Hence, the strength is prevented from being lowered, and the laminated portion is further hardened by being bent, with the result that the strength is enhanced without welding.

[0066] It is not necessary to cut or weld the side surfaces, and thus it is possible to manufacture the high-strength L-shaped square steel pipe 1A at low cost.

[0067] When a higher rigidity is needed, the bent portions or both folded side surfaces may be joined by welding joining or an adhesive.

[0068] Further, in the method for bending the square steel pipe 1 according to the present embodiment, as shown in Fig.7A, bending is performed twice on one square steel pipe 1, and thus it is possible to stably manufacture a square steel pipe 1B having two bent portions B at low cost.

[0069] Moreover, as shown in Fig.7B, bending is performed three times on the square steel pipe 1, and thus it is possible to stably manufacture a rectangular square steel pipe 1C having four bent portions C at low cost.

[0070] Hence, according to the present embodiment, it is possible to provide, at low cost, a household electrical appliance member such as a high-strength housing of a household electrical appliance or a pallet surface member, or a residential-related member such as a frame for a unit bath platform.

[0071] The manufacturing device 100 for the L-shaped square pipe which includes the buckling line forming device 2, the groove section forming device 3 and the bending device 15 described above is used, and thus it is possible to bend the square steel pipe 1 highly accurately, smoothly and stably.

[0072] However, the present invention is not limited to bending performed by the bending device described above, and the L-shaped square pipe may be formed without use of these devices (dies).

EXPLANATION OF REFERENCE NUMERALS

[0073]

1 square steel pipe
 1A L-shaped square steel pipe
 1a one surface
 1b other surface
 1c side surface
 1d side surface
 2 buckling line forming device
 3 groove section forming device
 4 buckling line
 5 groove section
 6 side surface pressing punch
 7 side surface holding portion
 8 groove section forming punch
 15 bending device
 100 manufacturing device
 A bent portion
 M center line in place where groove section is to be formed

before the groove section forming step, a buckling line forming step for forming buckling lines by pressing two side surfaces between the one surface of the square pipe and the other surface inward along a longitudinal direction of the side surfaces.

5. A device for manufacturing an L-shaped square pipe, the device comprising:

a groove section forming device for forming a groove section by pressing one surface of a square pipe along a shorter direction of the one surface to a side of an other surface located on a reverse side of the one surface; and
 a bending device for bending the square pipe such that both sides of the one surface sandwiching the groove section approach each other.

6. An L-shaped square pipe, wherein a square pipe is bent through a groove section provided along a shorter direction of one surface thereof.

Claims

1. A method for manufacturing an L-shaped square pipe, the method comprising:

a groove section forming step for forming a groove section by pressing one surface of a square pipe along a shorter direction of the one surface to a side of an other surface located on a reverse side of the one surface; and
 a bending step for bending the square pipe such that both sides of the one surface sandwiching the groove section approach each other.

2. The method for manufacturing an L-shaped square pipe according to claim 1, wherein in the groove section forming step, the groove section is formed by pressing, to the one surface, a corner portion of a V-shaped portion in a pressing member having the V-shaped portion.

3. The method for manufacturing an L-shaped square pipe according to claim 2, wherein an angle of the corner portion of the V-shaped portion corresponds to a bending angle of the square pipe.

4. The method for manufacturing an L-shaped square pipe according to any one of claims 1 to 3, the method further comprising,

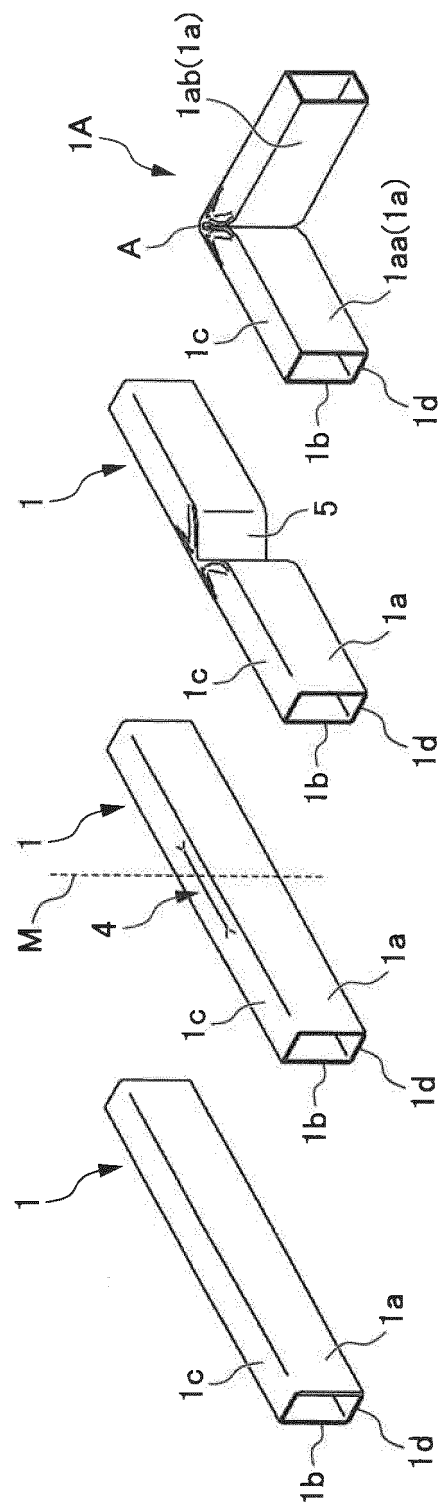


FIG. 1A

FIG. 1B

FIG. 1C

FIG. 1D

FIG. 2

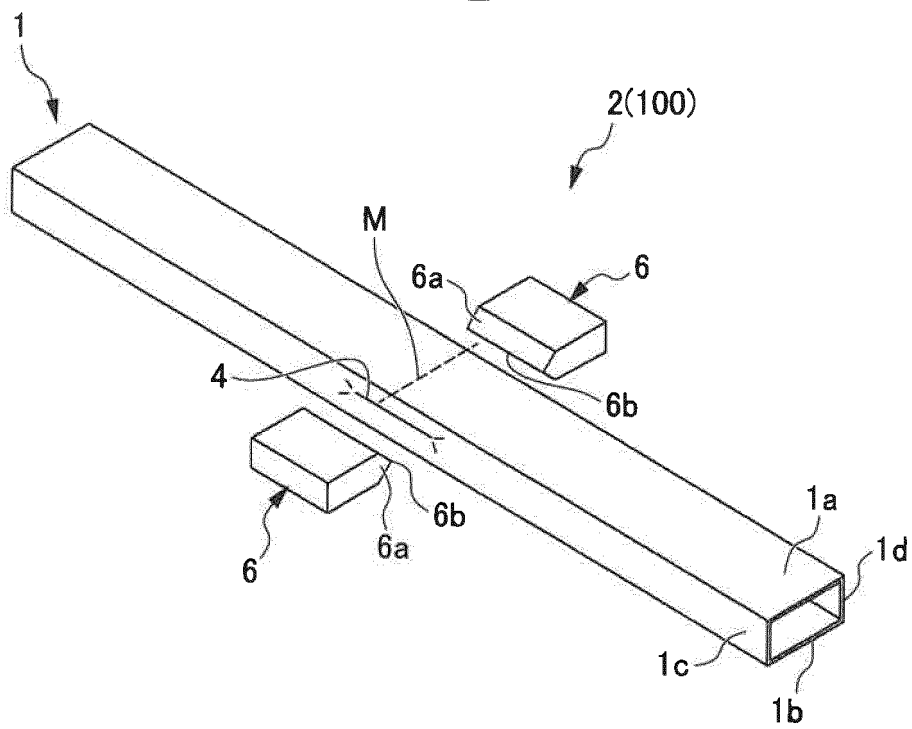


FIG. 3

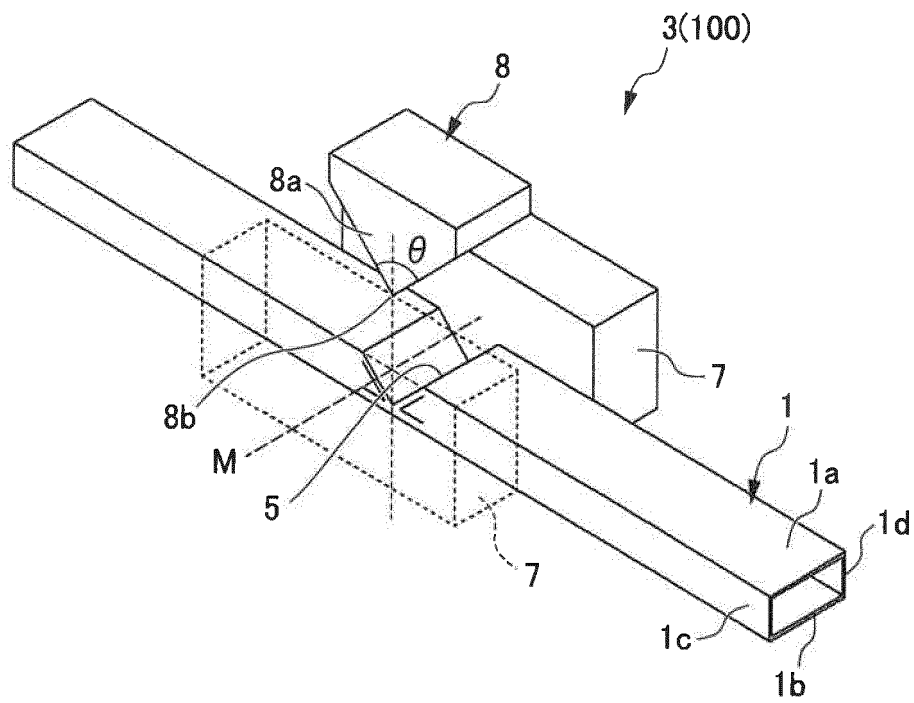


FIG. 4A

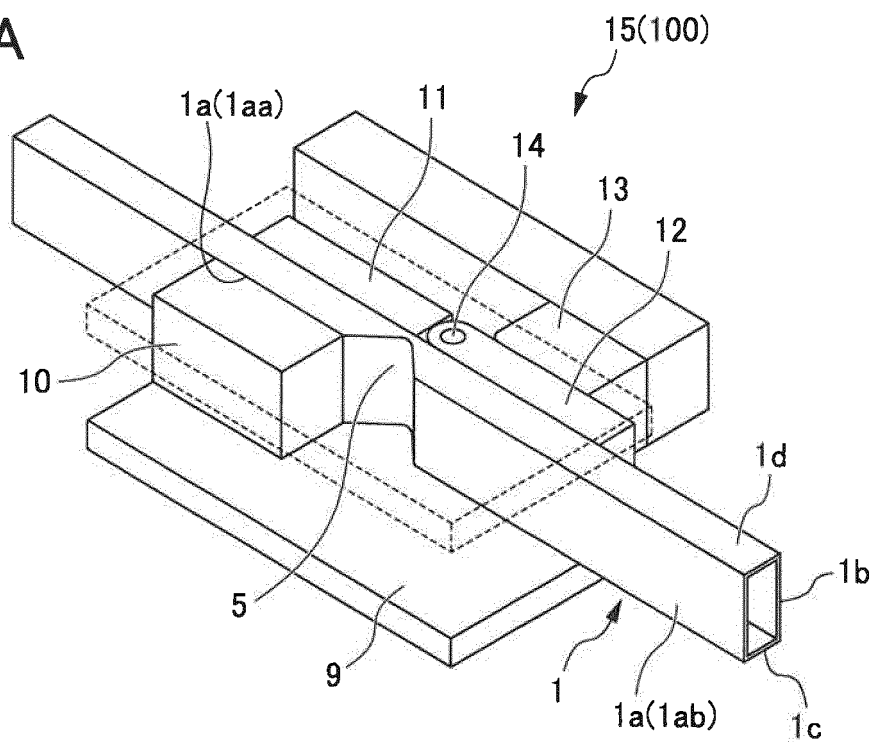


FIG. 4B

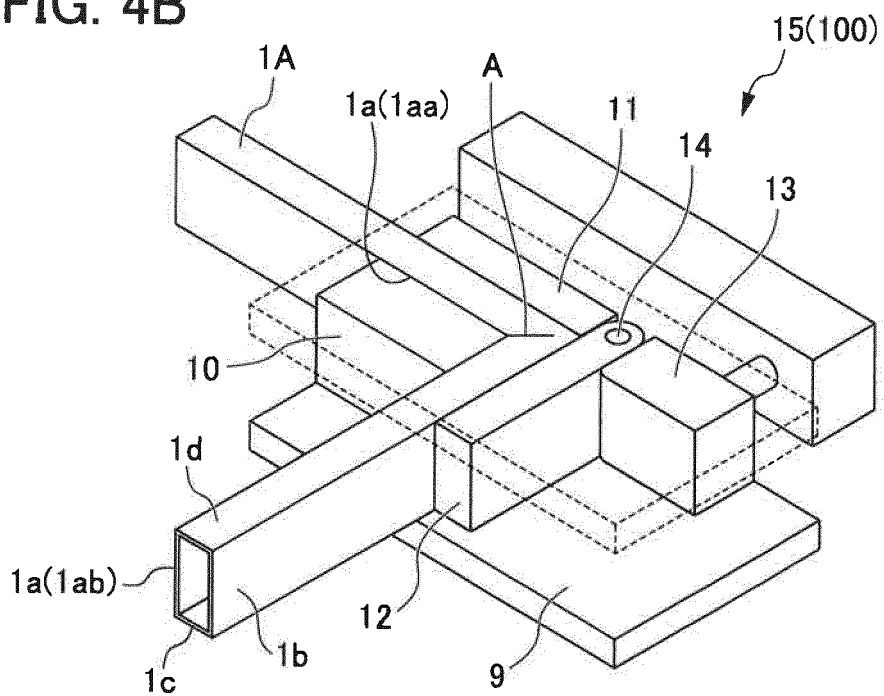


FIG. 5

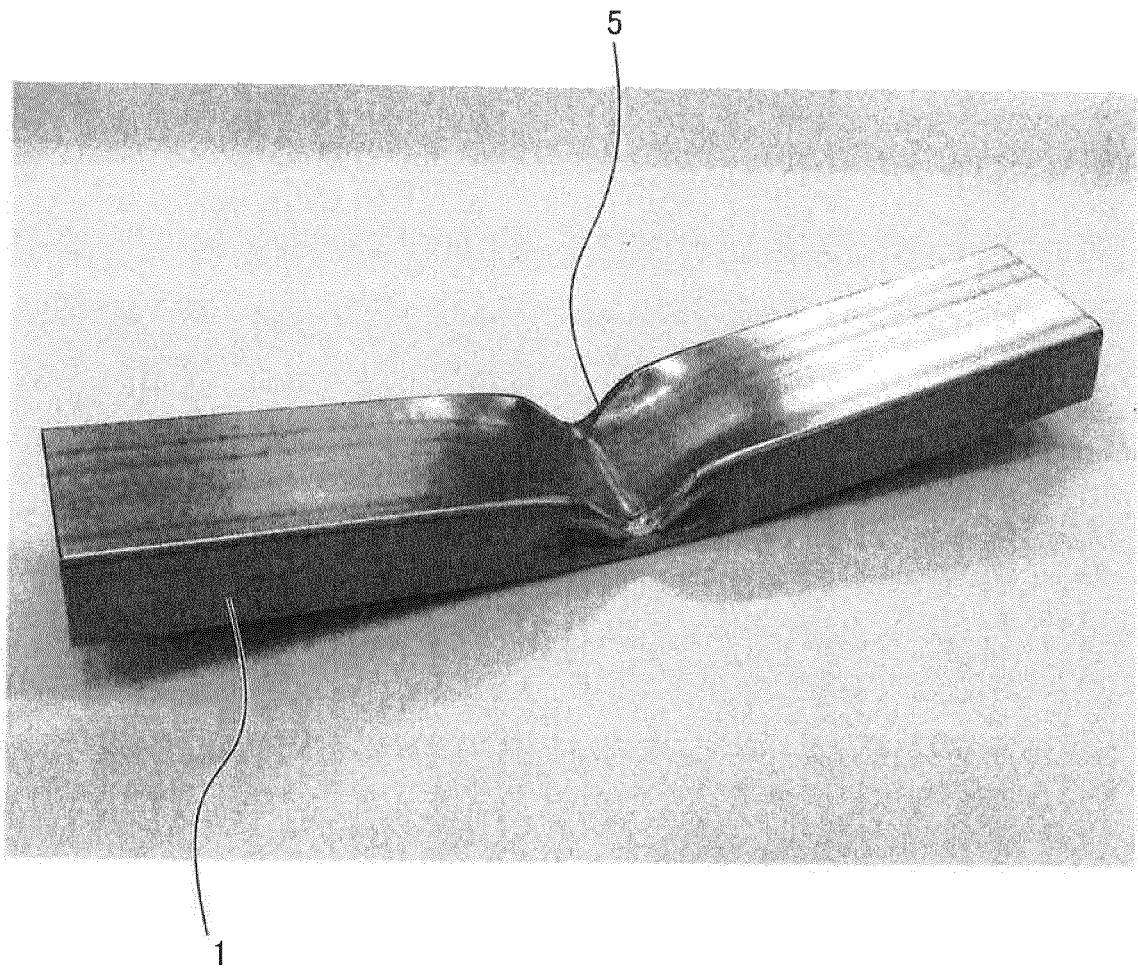


FIG. 6

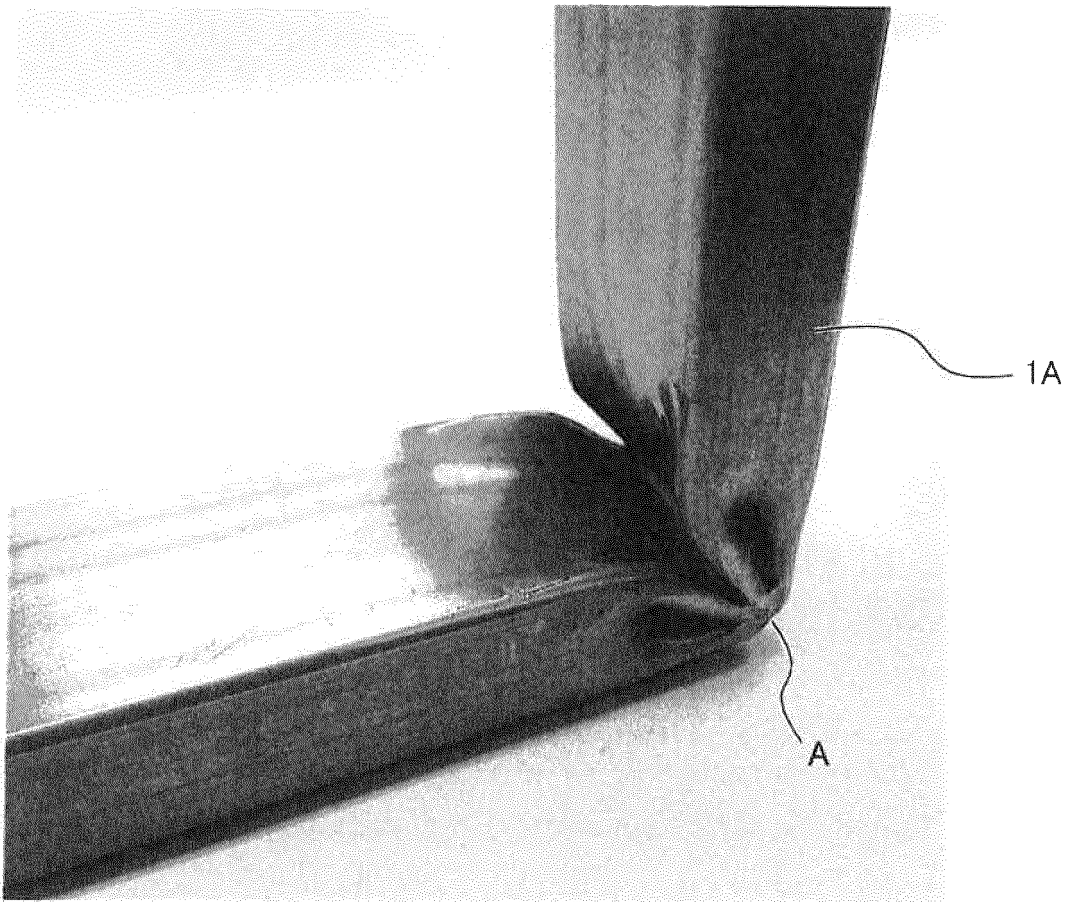


FIG. 7A

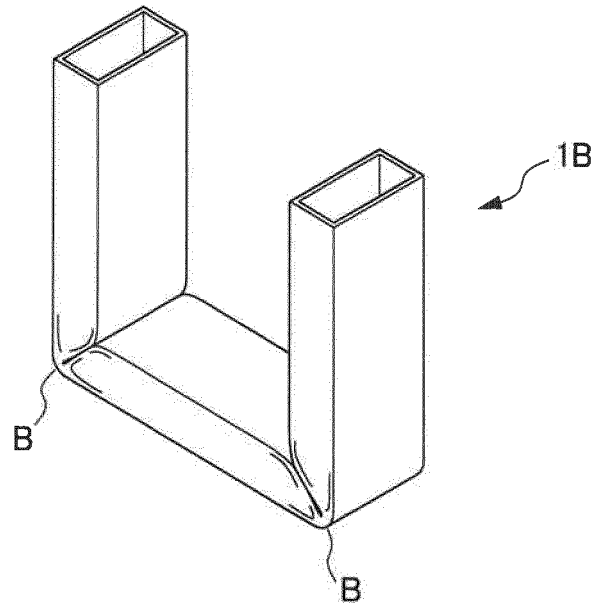
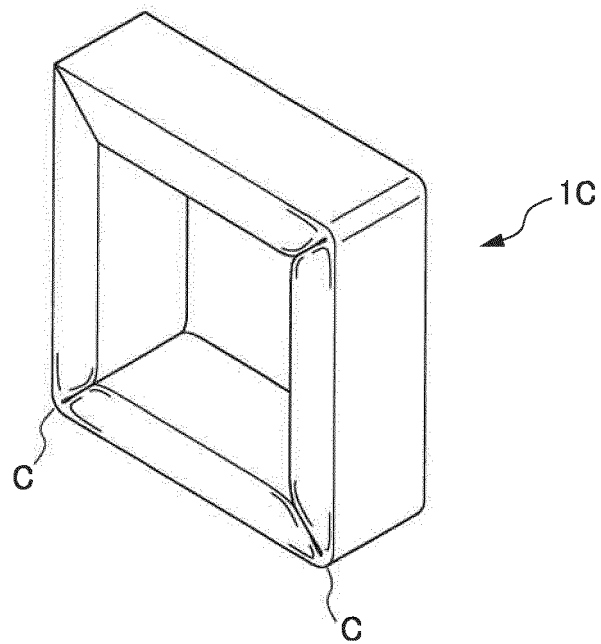


FIG. 7B



INTERNATIONAL SEARCH REPORT

International application No.

PCT/JP2016/070294

A. CLASSIFICATION OF SUBJECT MATTER

B21D7/00(2006.01) i, B21D11/08(2006.01) i

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

B21D7/00, B21D11/08

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Jitsuyo Shinan Koho 1922-1996 Jitsuyo Shinan Toroku Koho 1996-2016

Kokai Jitsuyo Shinan Koho 1971-2016 Toroku Jitsuyo Shinan Koho 1994-2016

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X Y	GB 1481712 A (RONALD JOHN BENTHAM), 03 August 1977 (03.08.1977), page 1, line 81 to page 4, line 21; fig. 1 to 7 (Family: none)	1-3, 5-6 4
Y	JP 2001-47140 A (Nippon Light Metal Co., Ltd.), 20 February 2001 (20.02.2001), paragraphs [0006] to [0009], [0019] to [0035]; fig. 1 to 5 (Family: none)	4
A	JP 1-241329 A (Seiji TSUGE), 26 September 1989 (26.09.1989), page 2, lower left column, line 20 to page 4, upper left column, line 11; fig. 1 to 7 (Family: none)	1-6

☒ Further documents are listed in the continuation of Box C.☐ See patent family annex.

* Special categories of cited documents:

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Date of the actual completion of the international search

08 September 2016 (08.09.16)

Date of mailing of the international search report

20 September 2016 (20.09.16)

Name and mailing address of the ISA/
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INTERNATIONAL SEARCH REPORT

International application No.

PCT/JP2016/070294

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	JP 39-29095 B1 (Okamura Corp.), 15 December 1964 (15.12.1964), page 1; fig. 1 to 4 (Family: none)	1-6

Form PCT/ISA/210 (continuation of second sheet) (January 2015)

REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- JP 2010201503 A [0006]