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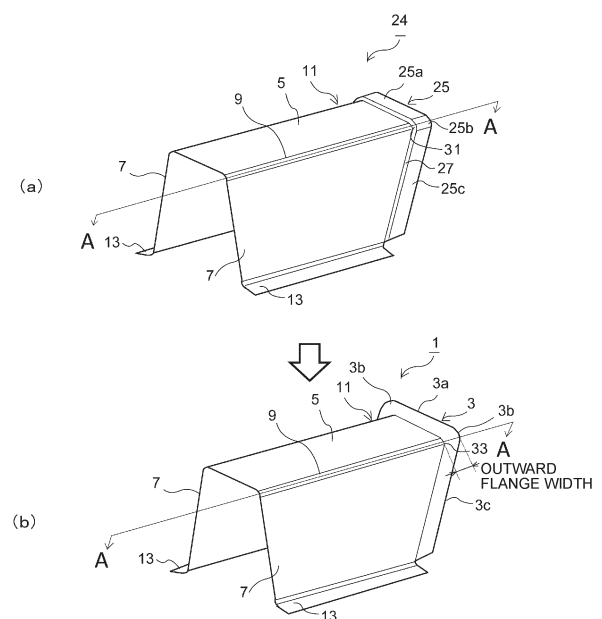
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(54) **METHOD FOR MANUFACTURING PRESS-MOLDED ARTICLE**

(57) A manufacturing method of a press formed part 1 according to the present invention is a manufacturing method of a press formed part 1 including a main body portion 11, which has a top plate portion 5 and vertical wall portions 7 formed via ridge portions 9, and an outward flange portion 3 formed continuously with the top plate portion 5, the ridge portions 9, and the vertical wall portions 7 at an end portion of the main body portion 11, the method including: an intermediate forming step of forming an intermediate formed part 24 that has the top plate portion 5 and the vertical wall portions 7 formed via the ridge portions 9 and has a step-shaped portion 27 at a root portion of an outward flange corresponding portion 25 in such a manner that the outward flange corresponding portion 25 bulges outward; and a target shape forming step of forming the outward flange portion 3 by bending and raising the outward flange corresponding portion 25 of the intermediate formed part 24 outward, and forming a target shape.

FIG.1



Description

Field

5 **[0001]** The present invention relates to a manufacturing method of a press formed part, and more specifically relates to a manufacturing method of a press formed part having a top plate portion and vertical wall portions continuous with the top plate portion via ridge portions, and including an outward flange portion continuously formed at end portions of the top plate portion, the ridge portions, and the vertical wall portions.

10 Background

[0002] As a vehicle body collision safety is being improved due to tightening of a vehicle collision safety standard, it is also necessary to reduce weight of the vehicle body in order to improve fuel consumption and to make a shift to electric vehicles according to carbon dioxide emission control. In order to achieve both the collision safety improvement and the weight reduction of the vehicle body, application of a high strength steel sheet (also referred to as high tensile strength steel material) having a tensile strength of 590 MPa-class or more to a vehicle body structural part is in progress.

15 **[0003]** For example, as illustrated in FIG. 4, as an automobile part, there is a press formed part 1 having a top plate portion 5, vertical wall portions 7, and ridge portions 9 that connect the top plate portion 5 and the vertical wall portions 7, and including an outward flange portion 3 formed continuously at end portions of the top plate portion 5, the ridge portions 9, and the vertical wall portions 7, such as a floor cross member.

20 **[0004]** In a case where such a press formed part 1 is press formed, a portion of the outward flange portion 3 which portion is continuous with the ridge portion 9 (hereinafter, referred to as a "corner flange portion") becomes a stretch flange deformation, and a fracture is likely to be generated at a tip portion of the corner flange portion 3b.

25 **[0005]** Conventionally, with respect to a manufacturing method of a press formed part having an outward flange portion continuously formed at the end portions of the vertical wall portions 7, Patent Literature 1 discloses a manufacturing method of a saddle-shaped press formed part. In Patent Literature 1, a top plate forming portion of a blank is curved, first force is applied from an inner surface side to an outer surface side of the blank, and combined force of second force in a direction facing each other and third force in a direction opposite to the first force is applied to each of the outer surface side of vertical wall forming portions, and press forming is performed. The method disclosed in Patent Literature 1 is a method of simultaneously forming a top plate portion, vertical wall portions, and an outward flange portion.

30 **[0006]** In addition, Patent Literature 2 discloses, as another press forming method, a press forming method of bending and raising an outward flange portion after forming a metal sheet into a U-shaped cross section. In the method disclosed in Patent Literature 2, when the outward flange portion is bent and raised, forming of the flange portion is started from a top plate portion and vertical wall portions, whereby it is assumed that a strain of the outward flange portion can be dispersed to a side of the top plate portion and sides of the vertical wall portions.

35 **[0007]** Patent Literature 3 discloses a press forming method of forming an outward flange by a shearing step of forming a step portion on a workpiece having a top plate, a vertical wall, and a flange, and a cutting step of cutting an unnecessary portion near the step portion.

40 Citation List

Patent Literature

45 **[0008]**

Patent Literature 1: WO 2019/216317

Patent Literature 2: WO 2022/049916

Patent Literature 3: WO 2016/194963

50 Summary

Technical Problem

55 **[0009]** In the method disclosed in Patent Literature 1, a structure of a die of press forming is considerably complicated, and a manufacturing cost of a die of press forming is high. In addition, since the combined force of the third force opposite to the first force is applied, it is difficult to perform press forming while pressing the blank sufficiently and uniformly, and it is also difficult to acquire a press formed part with high dimensional accuracy.

[0010] In this regard, as disclosed in Patent Literature 2, in the press forming method of bending and raising the outward

flange portion after forming the metal sheet into the U-shaped cross section, a die of press forming is simple and dimensional accuracy can be improved. However, in press forming of a high tensile strength steel material having further increased strength, there is a problem that buckling (wrinkles and fold) is likely to be generated at a connection portion between a ridge portion and a corner flange portion of the outward flange portion (hereinafter, simply referred to as a "connecting portion of a corner flange portion").

[0011] In addition, the method disclosed in Patent Literature 3 has a problem that a configuration of a die of press forming is complicated and the cutting step is essential.

[0012] The present invention has been made in view of the above problems, and an object thereof is to provide a manufacturing method of a press formed part which method is capable of stably manufacturing a press formed part with high dimensional accuracy without causing buckling in a connection portion of a corner flange portion without using a die of press forming having a complicated structure when manufacturing a press formed part having a top plate portion and vertical wall portions continuous to the top plate portion via ridge portions, and including an outward flange portion continuously formed at end portions of the top plate portion, the ridge portions, and the vertical wall portions.

Solution to Problem

[0013] In order to solve the above-described problems and achieve the object, (1) a manufacturing method of a press formed part, according to the present invention, is the method in which the press formed part includes at least a main body portion, which has a top plate portion and vertical wall portions formed via ridge portions, and an outward flange portion formed continuously with the top plate portion, the ridge portions, and the vertical wall portions at an end portion of the main body portion. The method includes: an intermediate forming step of forming an intermediate formed part having the top plate portion and the vertical wall portions formed via the ridge portions, and including a step-shaped portion bulging outward at a root portion of an outward flange corresponding portion which is to be formed into the outward flange portion; and a target shape forming step of forming the outward flange portion by bending and raising the outward flange corresponding portion of the intermediate formed part outward, and acquiring a target shape.

[0014] (2) Moreover, in the intermediate forming step according to above (1), the top plate portion, the ridge portions, the vertical wall portions, and the step-shaped portion may be press formed in one step.

[0015] (3) Moreover, in the intermediate forming step according to above (1), the step-shaped portion may be press formed after the top plate portion, the ridge portions, and the vertical wall portions are press formed. Advantageous Effects of Invention

[0016] A manufacturing method of a press formed part according to the present invention has an effect of being capable of stably manufacturing a press formed part with high dimensional accuracy without generating buckling at a connection portion of a corner flange portion without using a die of press forming having a complicated structure when manufacturing a press formed part having a top plate portion and vertical wall portions continuous to the top plate portion via ridge portions, and including an outward flange portion continuously formed at end portions of the top plate portion, the ridge portions, and the vertical wall portions.

Brief Description of Drawings

[0017]

FIG. 1 is a view for describing a manufacturing method of a press formed part according to an embodiment.

FIG. 2 is a view illustrating an analysis result of a forming process in a target shape forming step according to the embodiment.

FIG. 3 is a view schematically illustrating the forming process of the target shape forming step according to the embodiment.

FIG. 4 is a view for describing an example of a press formed part to be an object of the present invention.

FIG. 5 is a view of describing a conventional manufacturing method of a press formed part.

FIG. 6 is a view illustrating an analysis result of a forming process of forming an outward flange portion in a conventional example.

FIG. 7 is a view schematically illustrating the forming process of forming the outward flange portion in the conventional example.

Description of Embodiments

[0018] Hereinafter, an embodiment of a manufacturing method of a press formed part according to the present invention will be described. Note that the present invention is not limited by the present embodiment.

[0019] Before a description of the embodiment of the present invention, a shape of a press formed part to be an object of

the present invention will be described with reference to FIG. 4 illustrating an example thereof. As illustrated in FIG. 4, the object of the present invention is a press formed part 1 having an outward flange portion 3, and a main body portion 11 having a top plate portion 5, vertical wall portions 7, and ridge portions 9 connecting the top plate portion 5 and the vertical wall portions 7 is included. At an end portion of the main body portion 11, the press formed part 1 has the outward flange portion 3 formed continuously with the top plate portion 5, the ridge portions 9, and the vertical wall portions 7. In the example illustrated in FIG. 4, the press formed part 1 includes a horizontal flange portion 13 at a lower end of each of the vertical wall portions 7. Note that in the following description, portions of the outward flange portion 3 which portions are respectively continuous with the top plate portion 5, the ridge portions 9, and the vertical wall portions 7 are respectively referred to as a top plate flange portion 3a, corner flange portions 3b, and vertical wall flange portions 3c.

[0020] FIG. 5 is a view illustrating a conventional forming method of a press formed part 1. Conventionally, as illustrated in FIG. 5(a), an intermediate formed part 15 including a top plate portion 5, ridge portions 9, vertical wall portions 7, and a horizontal flange portion 13 at a lower end of each of the vertical wall portions 7 is first formed. At an end portion of the intermediate formed part 15, the top plate portion 5, the ridge portions 9, and the vertical wall portions 7 are extended, and the extended portion serves as an outward flange portion 3 (top plate flange portion 3a, corner flange portions 3b, and vertical wall flange portions 3c) in a target shape. Thus, in the present embodiment, the extended portion is referred to as an outward flange corresponding portion 17. Each portion of the intermediate formed part 15 may be press formed simultaneously or may be press formed for each portion. Then, as illustrated in FIG. 5(b), the outward flange corresponding portion 17 in the intermediate formed part 15 is bent and raised outward, whereby the outward flange portion 3 is formed and the press formed part 1 having the target shape is acquired.

[0021] As a forming method of bending and raising the outward flange corresponding portion 17, for example, as disclosed in Patent Literature 2, first, bending force is input to a top plate flange corresponding portion 17a and a vertical wall flange corresponding portion 17c. Then, in a forming method of bending and raising the outward flange corresponding portion 17 thereafter, bending force may be input to a corner flange corresponding portion 17b.

[0022] FIG. 6 is a view illustrating a result of FEM analysis in a case where a steel sheet having a sheet thickness of 1.4 mm and tensile strength of 590 MPa-class is used, and a height of the outward flange portion 3 is 18 mm and R at a boundary portion between the top plate portion 5, the ridge portions 9, and the vertical wall portions 7 and the outward flange portion 3 is 3 mm as a target shape. In FIG. 6, a state of the intermediate formed part 15 before forming of the outward flange portion 3 (FIG. 6(a)) to a state of a bottom dead center of forming after bending and raising of the outward flange portion 3 (FIG. 6(d)) are illustrated with intermediate stages.

[0023] Tension acts on a tip portion of the outward flange portion 3, and a sheet thickness decreases. On the other hand, large compressive force acts on a connection portion 35 of the corner flange portion 3b (see FIG. 4). Thus, the sheet thickness increases due to the compressive force, a maximum sheet thickness increase rate at the bottom dead center of forming becomes 47%, and wrinkles and folds are generated (see FIG. 6(d)). Here, the sheet thickness increase rate is acquired by acquisition of a difference between a sheet thickness at a corresponding portion and a sheet thickness of a metal sheet as a blank and calculation of a ratio to the sheet thickness of the metal sheet as the blank.

[0024] FIG. 7 is a view schematically illustrating a study result acquired by studying of a process in which the wrinkles and folds are generated in conventional press forming in more detail. In FIG. 7, states of a punch 19, a die 20, a lower pad 21, and a metal sheet 23 from a middle of forming (38 mmup) (FIG. 7(a)) to a vicinity of the bottom dead center of forming (4 mmup) (FIG. 7(e)) are illustrated with respect to a cross section cut in a direction of an arrow A along the ridge portion 9 of the press formed part 1 illustrated in FIG. 5. Note that a numerical value such as [30 mmup] is a distance in a press forming direction in which distance a sheet thickness to the bottom dead center of forming of the die 20 at the position is considered. Thus, for example, the position of the die 20 at the time of "30 mmup" is +30 mm in an opposite direction of the press forming from a bottom dead center of pressing.

[0025] As illustrated in FIG. 7, the outward flange corresponding portion 17 that is an end portion of the metal sheet 23 starts coming into contact with the punch 19 at [38 mmup], and the outward flange corresponding portion 17 of the metal sheet 23 is bent and deformed in a direction of the die 20 at [30 mmup]. Then, at [24 mmup], the outward flange corresponding portion 17 is bent at a position away from the die 20 and folded in such a manner that the tip portion approaches a side of the die 20. Furthermore, as the forming proceeds, a fold is generated between the lower pad 21 and a forming surface of the punch 19 at [10 mmup], the fold remains as it is even when the forming proceeds to [4 mmup], and wrinkles are generated or the fold remains at the bottom dead center of forming.

[0026] A reason for such a formed shape is that the corner flange corresponding portion 17b that is an extension of the ridge portion 9 is not wound along the die 20 since the ridge portion 9 passes therethrough and rigidity against bending is high, and is folded at a position away from the die 20 (see FIG. 7(c)). In addition, in the present example, the vertical wall flange portion 3c (see FIG. 6) is not perpendicular to a surface of the top plate portion 5 of the press formed part 1 and is inclined inward. Thus, a large gap is generated between a flange forming portion of the punch 19 and a flange forming portion of the die 20 at an initial stage of the press forming.

[0027] In considering a measure for preventing the fold of the connection portion 35 of the corner flange corresponding portion 17b, the present inventor has paid attention to a deformation of the metal sheet 23 in [30 mmup] to [24 mmup] of

FIG. 7. Such a deformation is generated by a free deformation of the end portion of the metal sheet 23 and generation of the fold. In order to prevent this deformation, it is conceivable to restrain the free deformation of the end portion of the metal sheet 23. However, since it is necessary to form the corner flange corresponding portion 17b into the corner flange portion 3b, it is difficult to completely restrain the end portion of the metal sheet 23 with a die of press forming. Thus, the present inventors have reached an idea that the above-described fold can be prevented when a portion corresponding to a root of the outward flange portion 3 of the metal sheet 23 can be wound around the die 20 in an initial stage of the press forming. The present invention is based on such an idea, and is specifically described below.

[0028] As illustrated in an example in FIG. 1(a), a step-shaped portion 27 that is a step bulging outward is provided at a root portion of an outward flange corresponding portion 25 (top plate flange corresponding portion 25a, corner flange corresponding portion 25b, and vertical wall flange corresponding portion 25c) in an intermediate formed part 24. Then, in such an intermediate formed part 24, the outward flange corresponding portion 25 is formed into the outward flange portion 3 (top plate flange portion 3a, corner flange portion 3b, and vertical wall flange portion 3c) and a target shape is acquired. In such an intermediate formed part 24, winding around the die 20 becomes easier in the initial stage of press forming and the above-described fold can be prevented by provision of the step-shaped portion 27.

[0029] FIG. 2(a) to FIG. 2(d) are views illustrating a result of an FEM analysis of the press forming process of the intermediate formed part 24 to the target shape. In FIG. 2(a), the intermediate formed part 24 (before flange forming) in which the step-shaped portion 27 is formed is illustrated. FIG. 2(b) to FIG. 2(d) are views illustrating a forming process of the flange portion.

[0030] Tension acts on a tip portion of the outward flange portion 3, and a sheet thickness decreases. In addition, compressive force acts on a connection portion 33 between the ridge portion 9 and the corner flange portion 3b (see FIG. 1(b)), and the sheet thickness increases. On the other hand, the maximum sheet thickness increase rate at the bottom dead center of forming is 28%, and is significantly reduced as compared with the maximum sheet thickness increase rate of 47% in FIG. 6(d) illustrating the conventional example, and it can be seen that wrinkles can be prevented. As one of the reasons why the maximum sheet thickness increase rate is reduced, in the present invention, the sheet thickness increase portion of a connection portion 31 between the ridge portion 9 and the corner flange corresponding portion 25b (see FIG. 1(a)) is dispersed in [10 mmup] illustrated in FIG. 2(c) as compared with conventional [10 mmup] illustrated in FIG. 6(c).

[0031] FIG. 3 is a view schematically illustrating a forming process of forming the intermediate formed part 24 into a target shape in the press forming of the present invention. In FIG. 3, states of a punch 19, a die 20, a lower pad 21, and a metal sheet 23 in a process from [38 mmup] to [4 mmup] with respect to a cross section cut in a direction of an arrow A along the ridge portion 9 as illustrated in FIG. 1.

[0032] As illustrated in FIG. 3, the connection portion 31 between the ridge portion 9 and the corner flange corresponding portion 25b is wound around the die 20 from [38 mmup] to [30 mmup] since the step-shaped portion 27 is formed. Subsequently, the outward flange corresponding portion 25 starts coming into contact with the punch 19 at [30 mmup], and the tip of the metal sheet 23 is bent toward a side of the die 20 at [24 mmup]. At that time, since the step-shaped portion 27 is formed, the tip of the outward flange corresponding portion 25 does not approach the side of the die 20. Thus, the connection portion 31 between the ridge portion 9 and the corner flange corresponding portion 25b (see FIG. 1(a)) is not bent at an acute angle. In this regard, at [24 mmup] of FIG. 7 illustrating the conventional example, the tip of the outward flange corresponding portion 25 approaches the side of the die 20, and the connection portion 35 between the ridge portion 9 and the corner flange portion 3b (see FIG. 4) is bent at an acute angle.

[0033] Furthermore, as the press forming proceeds, the outward flange corresponding portion 25 is formed without being folded at a gap between the die 20 and the punch 19 at [10 mmup]. Then, the forming proceeds to [4 mmup], the outward flange portion 3 is formed at the bottom dead center of forming, and the connection portion 33 between the ridge portion 9 and the corner flange portion 3b (see FIG. 1(b)) does not become wrinkles. As described above, in the present embodiment, since the step-shaped portion 27 is provided, the connection portion 31 between the ridge portion 9 and the corner flange corresponding portion 25b is wound around the die 20 in the initial stage of the forming. As a result, the connection portion does not enter a gap between the lower pad 21 and the punch 19 and is not folded, and generation of the wrinkles is prevented.

[0034] Note that the step-shaped portion 27 formed in an intermediate forming step can be press formed simultaneously with the forming of the top plate portion 5, the vertical wall portions 7, and the ridge portions 9. Since forming is performed in one step, manufacturing becomes efficient. Alternatively, the step-shaped portion 27 may be press formed after the top plate portion 5, the vertical wall portions 7, and the ridge portions 9 are formed.

[0035] In addition, in a target shape forming step of forming the outward flange portion 3, as disclosed in Patent Literature 2, first, bending force is input to the top plate flange corresponding portion 25a and the vertical wall flange corresponding portion 25c. Then, the bending force is preferably input to the corner flange corresponding portion 25b. In such a manner, it is possible to prevent a fracture from being generated at the tip of the corner flange portion 3b.

[0036] Note that in the above description, although the vertical wall portions 7 are provided on both sides of the top plate portion 5, the horizontal flange portions 13 are included at the lower ends of the vertical wall portions 7, and an orthogonal cross section of the ridge portions 9 has a hat shape, the present invention is not limited thereto. That is, the present

invention may be applied to one which has no horizontal flange portion 13 and in which an orthogonal cross section of the ridge portions 9 has a U-shape, or one having a Z-shape or an L-shape acquired by half-splitting of one having a hat-shape or a U-shape in a direction of the ridge portions 9 in the top plate portion 5. In addition, in order to form the step-shaped portion bulging outward in the present invention, bending forming or drawing forming is preferable. Since the step-shaped portion is bent and the outward flange portion 3 is formed, the forming is easy even when a width of the outward flange portion 3 is wide. On the other hand, when the step-shaped portion is formed by the shear forming described in Patent literature 3, there is a not preferable case since a width of the flange portion is restricted due to a breaking limit of a material.

[Example]

[0037] In the present example, in order to confirm an effect of the present invention, a press forming analysis of the press formed part 1 that is illustrated in FIG. 4 and is the object of the present invention, and press forming of a real material were performed. As the high tensile strength steel material, a 980 MPa-class steel sheet having a sheet thickness of 1.4 mm was used. The press formed part 1 has a hat shape in which the top plate portion 5 has a width of 84 mm, the vertical wall portions 7 have a height of 100 mm, and the ridge portions 9 have a length of 180 mm. For the outward flange portion 3, an outward flange width defined in FIG. 1(b) was set to 16 mm, and a sheet inner curvature radius R of the root portion was set to 3 mm in the cross section cut in the direction of the arrow A along the ridge portion 9.

[0038] In addition, in the present example, a press forming analysis of forming the outward flange portion 3 was performed as the conventional example and the invention example for the intermediate formed part 15 (see FIG. 5(a)) that is press formed by utilization of a blank model of the high tensile strength steel material. As the conventional example, as illustrated in FIG. 5 and FIG. 6, a press forming analysis of forming the outward flange portion 3 was performed without provision of the step-shaped portion 27 at the root portion of the corner flange corresponding portion 17b. In addition, as the invention example, as illustrated in FIG. 1(a), a press forming analysis of forming the outward flange portion 3 was performed on the intermediate formed part 24 with the step-shaped portion 27 being provided at the root portion of the corner flange corresponding portion 25b. In addition, in the invention example, a height of the step-shaped portion 27, that is, a difference in height between the step-shaped portion 27 and the top plate portion 5 was changed from 1.0 mm to 2.5 mm and the press forming analysis was performed, and an influence of the height of the step-shaped portion 27 was also compared. Note that the sheet thickness increase rate of the connection portion 33 or the connection portion 35 between the ridge portion 9 and the corner flange portion 3b was acquired from the sheet thickness of the connection portion on the basis of a sheet thickness of the blank model. Results of the analysis are illustrated in Table 1.

Table 1

No.	Height of step-shaped portion (mm)	Sheet thickness increase rate of connection portion (%)	Note
1	No step	47.6	Conventional example
2	1.0	35.2	Invention example
3	1.5	28.2	Invention example
4	2.0	25.0	Invention example
5	2.5	25.9	Invention example

[0039] In a case of No. 1 that is the conventional example in which the step-shaped portion 27 is not provided, the maximum sheet thickness increase rate was as large as 47.6%. In the actual press material, buckling (wrinkles and fold) was generated at the connection portion 35 between the ridge portion 9 and the corner flange portion 3b. On the other hand, in each of invention examples No. 2 to No. 5 in which the step-shaped portion 27 was provided, the maximum sheet thickness increase rate was greatly decreased as the analysis result. In addition, buckling was not generated in actual press materials of these. Note that in a case of No. 4 in which the height of the step-shaped portion 27 was 2.0 mm, the maximum sheet thickness increase rate was 25%, was decreased the most, and was almost halved compared to 47.6% of the conventional example. As described above, it has been demonstrated that buckling of the connection portion 33 between the ridge portion 9 and the corner flange portion 3b can be prevented by provision of the step-shaped portion 27 in the intermediate formed part 24 of the present invention.

Industrial Applicability

[0040] The present invention can provide a manufacturing method of a press formed part which method is capable of stably producing a press formed part with high dimensional accuracy without using a die of press forming having a

complicated structure and without generating buckling at a connection portion of a corner flange portion.

Reference Signs List

5 [0041]

- 1 PRESS FORMED PART
- 3 OUTWARD FLANGE PORTION
- 3a TOP PLATE FLANGE PORTION
- 10 3b CORNER FLANGE PORTION
- 3c VERTICAL WALL FLANGE PORTION
- 5 TOP PLATE PORTION
- 7 VERTICAL WALL PORTION
- 9 RIDGE PORTION
- 15 11 MAIN BODY PORTION
- 13 HORIZONTAL FLANGE PORTION
- 15 INTERMEDIATE FORMED PART (CONVENTIONAL EXAMPLE)
- 17 OUTWARD FLANGE CORRESPONDING PORTION (CONVENTIONAL EXAMPLE)
- 17a TOP PLATE FLANGE CORRESPONDING PORTION (CONVENTIONAL EXAMPLE)
- 20 17b CORNER FLANGE CORRESPONDING PORTION (CONVENTIONAL EXAMPLE)
- 17c VERTICAL WALL FLANGE CORRESPONDING PORTION (CONVENTIONAL EXAMPLE)
- 19 PUNCH
- 20 DIE
- 21 LOWER PAD
- 25 23 METAL SHEET
- 24 INTERMEDIATE FORMED PART (INVENTION EXAMPLE)
- 25 OUTWARD FLANGE CORRESPONDING PORTION (INVENTION EXAMPLE)
- 25a TOP PLATE FLANGE CORRESPONDING PORTION (INVENTION EXAMPLE)
- 25b CORNER FLANGE CORRESPONDING PORTION (INVENTION EXAMPLE)
- 30 25c VERTICAL WALL FLANGE CORRESPONDING PORTION (INVENTION EXAMPLE)
- 27 STEP-SHAPED PORTION
- 31 CONNECTION PORTION BETWEEN RIDGE PORTION AND CORNER FLANGE PORTION OF INTERMEDIATE FORMED PART (INVENTION EXAMPLE)
- 33 CONNECTION PORTION BETWEEN RIDGE PORTION AND CORNER FLANGE PORTION OF PRESS FORMED PART (INVENTION EXAMPLE)
- 35 35 CONNECTION PORTION BETWEEN RIDGE PORTION AND CORNER FLANGE PORTION (CONVENTIONAL EXAMPLE)

40 Claims

1. A manufacturing method of a press formed part, the press formed part including at least
 - a main body portion, which has a top plate portion and vertical wall portions formed via ridge portions, and
 - an outward flange portion formed continuously with the top plate portion, the ridge portions, and the vertical wall portions at an end portion of the main body portion, the method comprising:
 - an intermediate forming step of forming an intermediate formed part having the top plate portion and the vertical wall portions formed via the ridge portions, and including a step-shaped portion bulging outward at a root portion of an outward flange corresponding portion which is to be formed into the outward flange portion; and
 - a target shape forming step of forming the outward flange portion by bending and raising the outward flange corresponding portion of the intermediate formed part outward, and acquiring a target shape.
2. The manufacturing method of a press formed part according to claim 1, wherein in the intermediate forming step, the top plate portion, the ridge portions, the vertical wall portions, and the step-shaped portion are press formed in one step.

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3. The manufacturing method of a press formed part according to claim 1, wherein in the intermediate forming step, the step-shaped portion is press formed after the top plate portion, the ridge portions, and the vertical wall portions are press formed.

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FIG.1

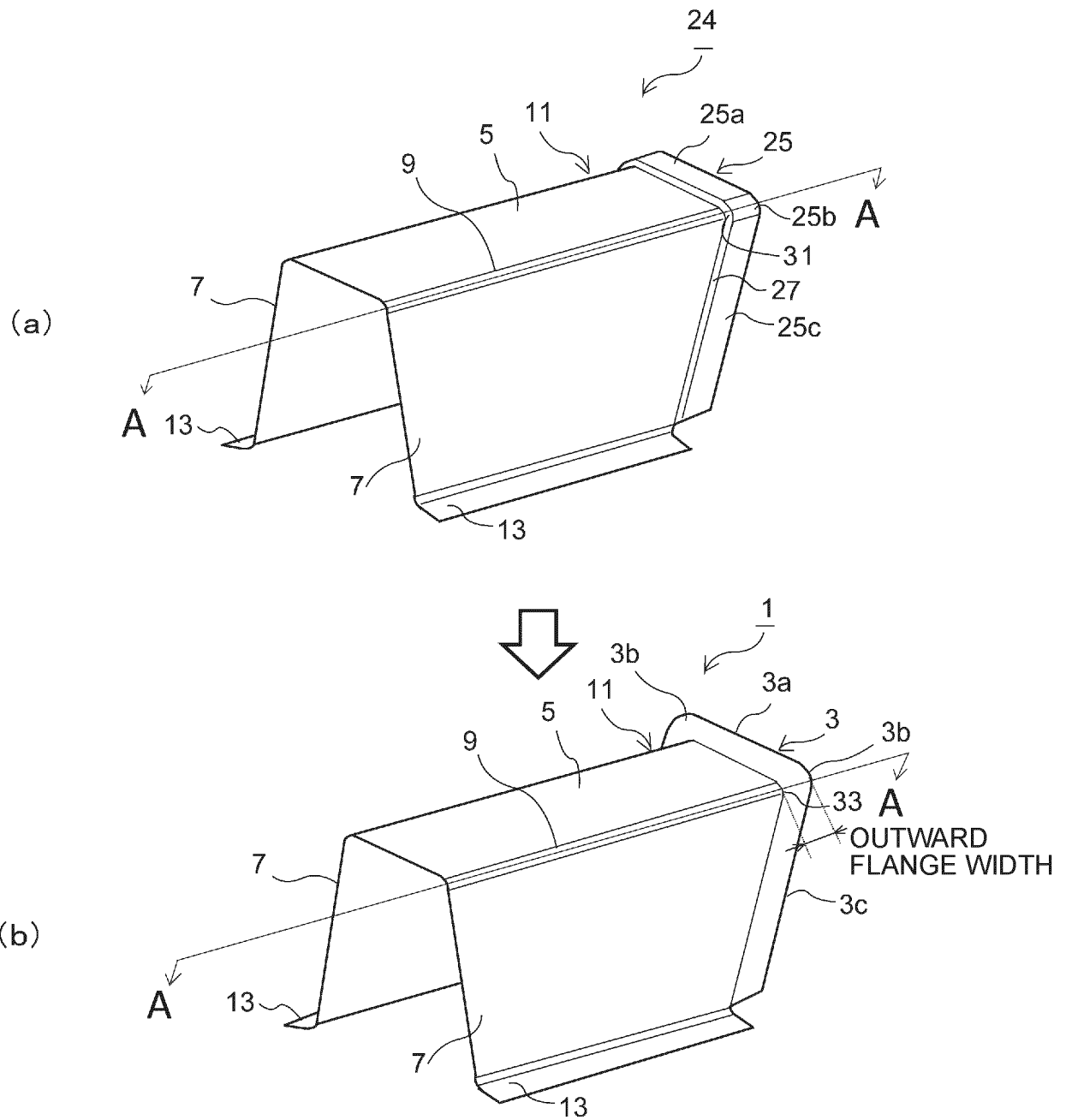
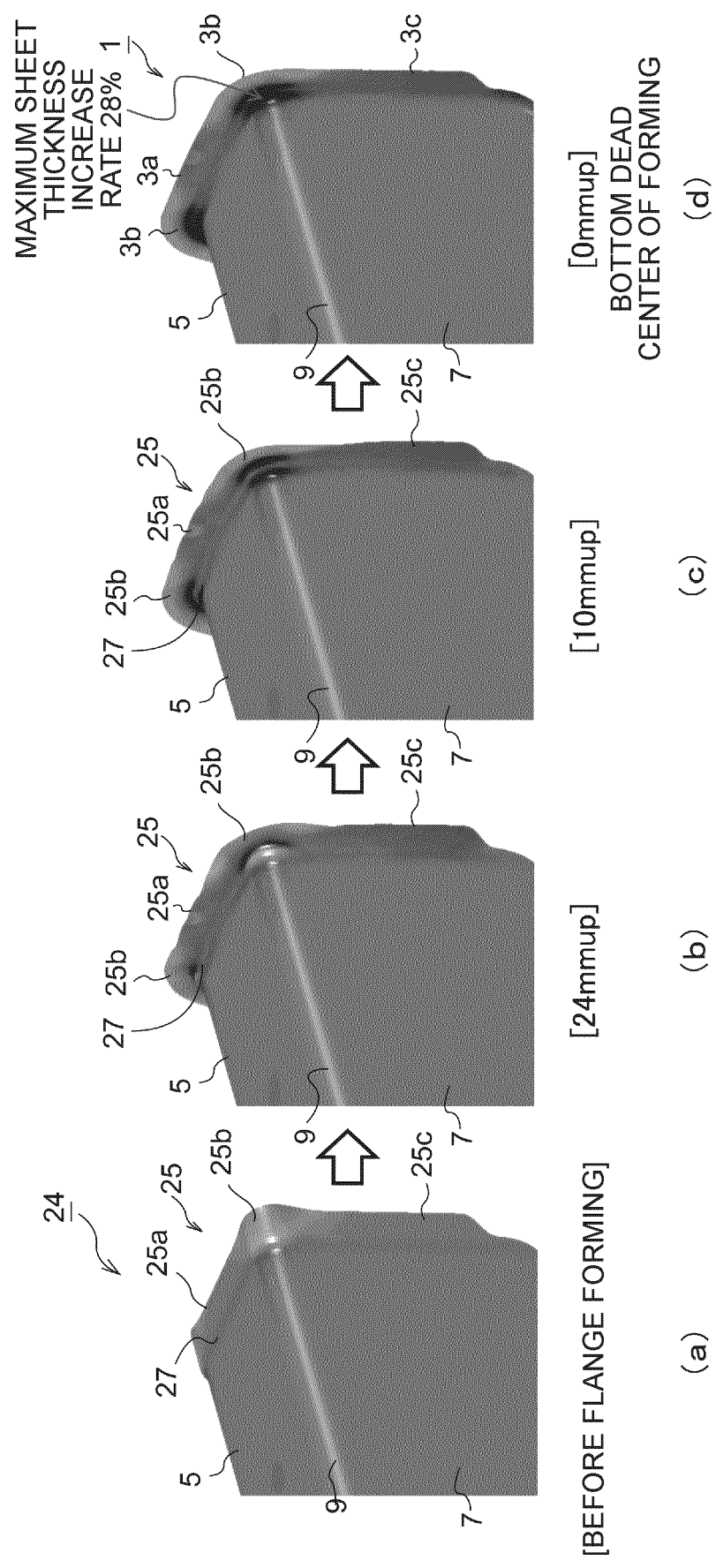


FIG.2



3. GG
EE

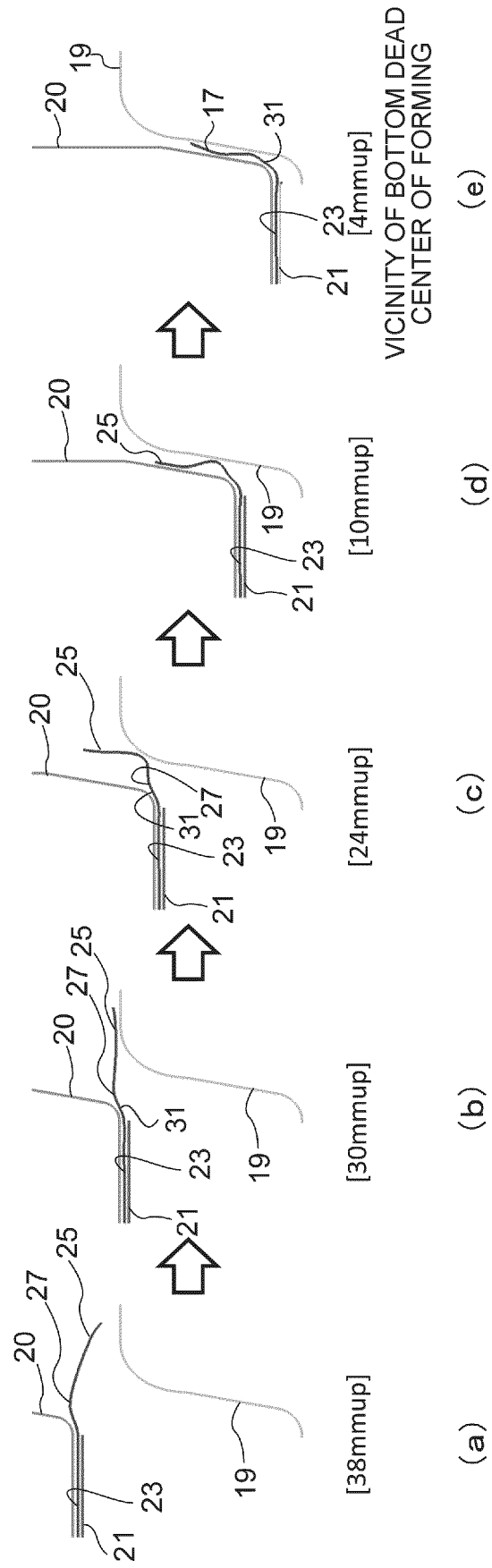


FIG.4

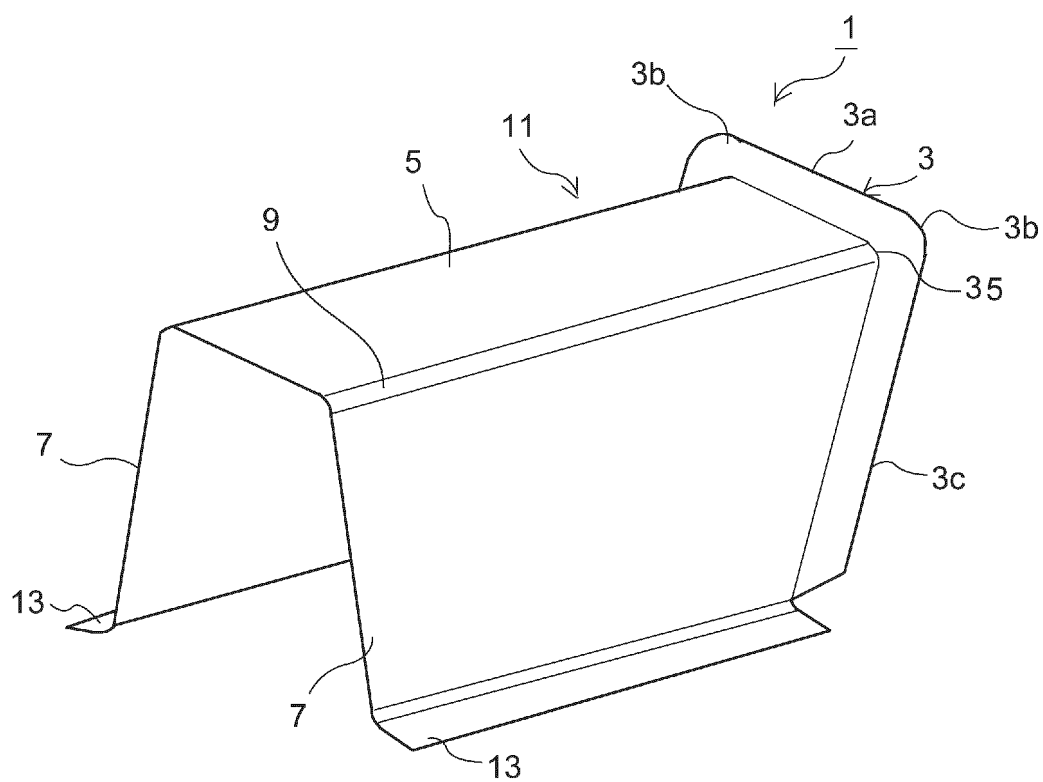


FIG.5

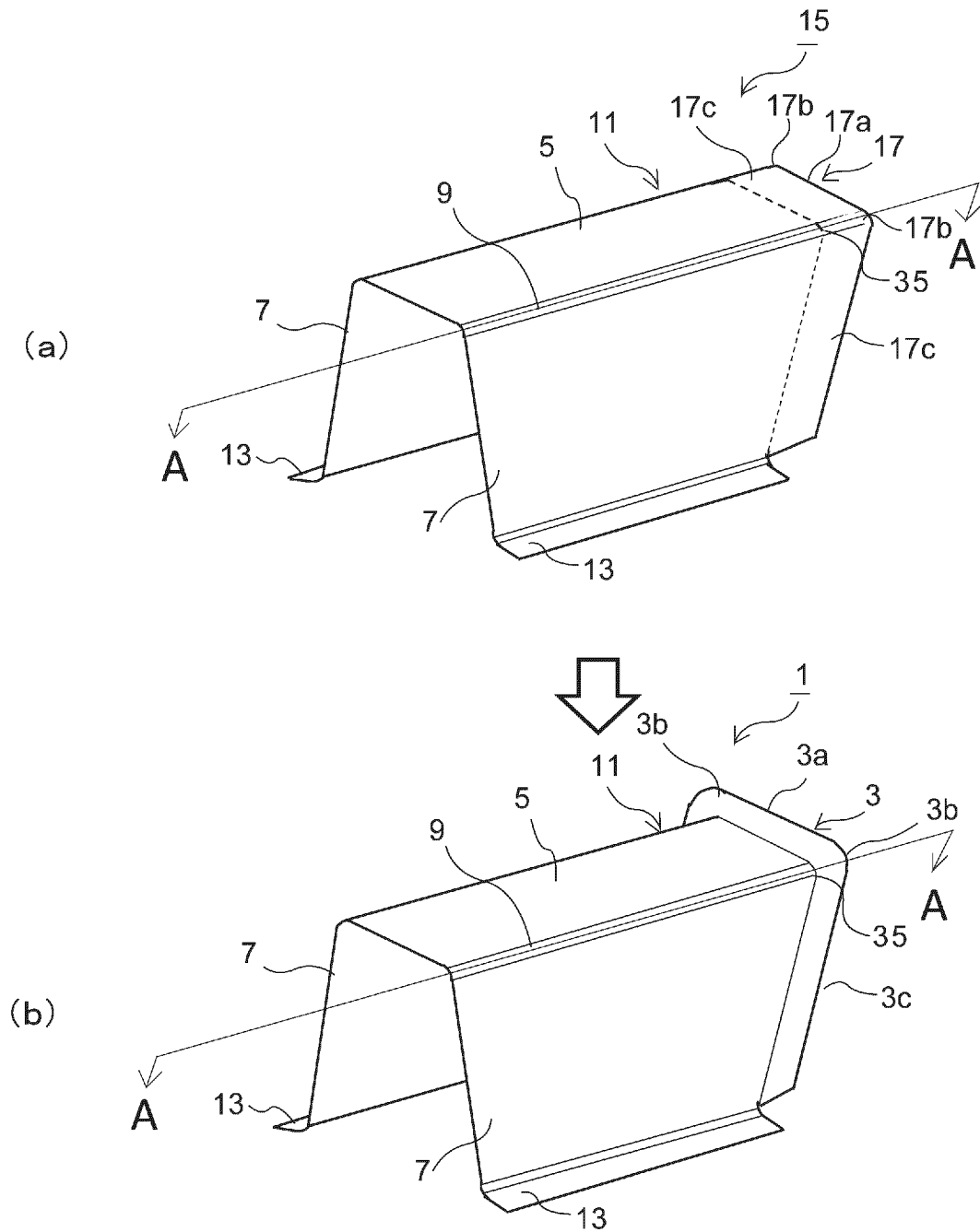


FIG.6

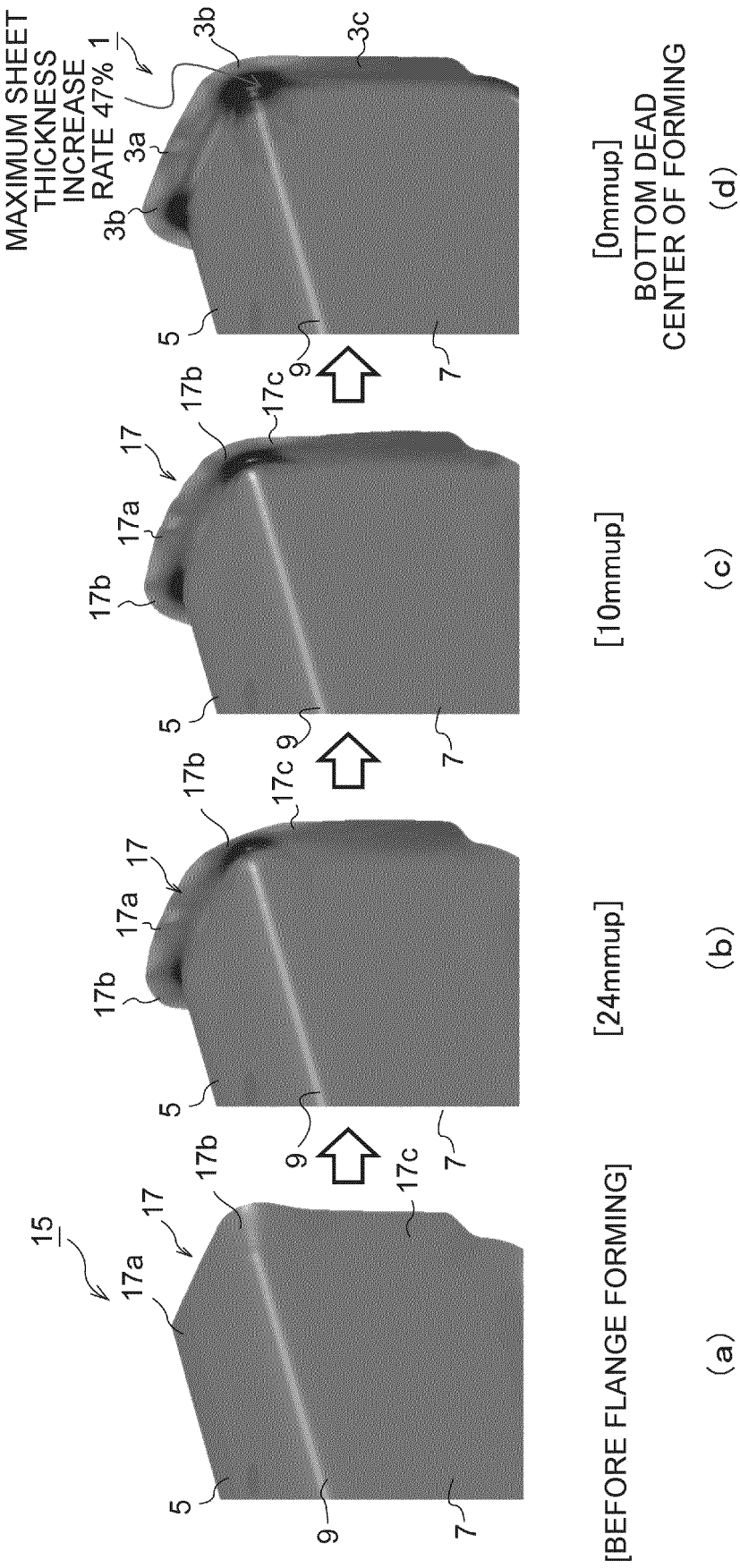
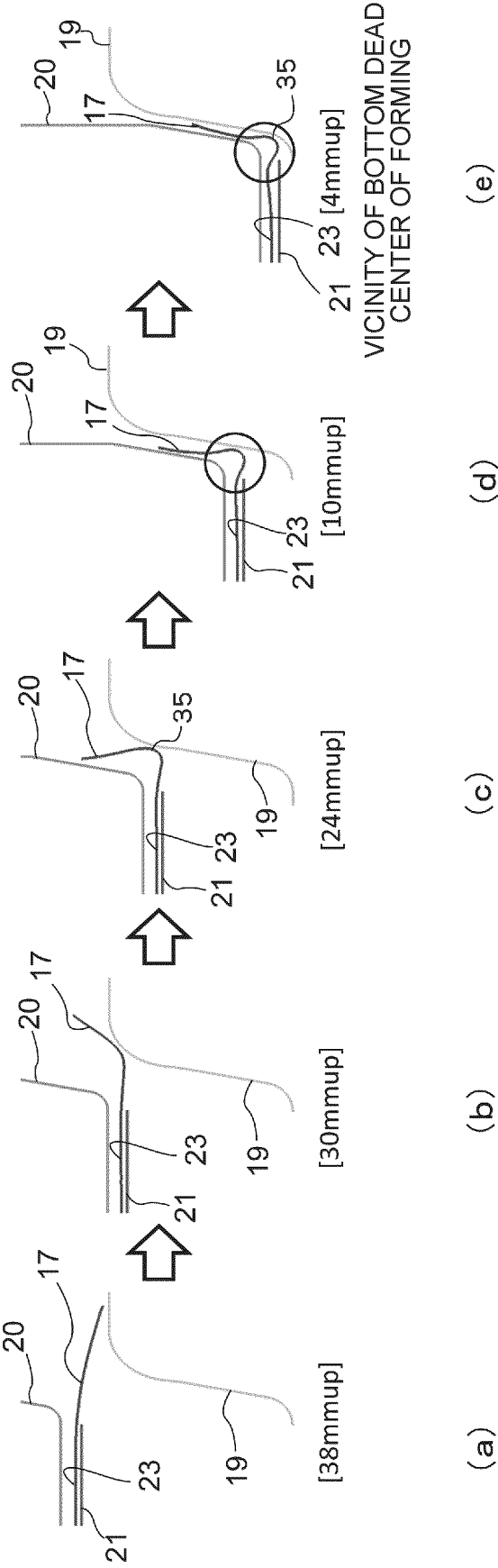


FIG.7



INTERNATIONAL SEARCH REPORT

International application No.

PCT/JP2023/019071

A. CLASSIFICATION OF SUBJECT MATTER

B21D 22/26(2006.01)i

FI: B21D22/26 C

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)

B21D22/26

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

Published examined utility model applications of Japan 1922-1996
 Published unexamined utility model applications of Japan 1971-2023
 Registered utility model specifications of Japan 1996-2023
 Published registered utility model applications of Japan 1994-2023

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	JP 2022-91379 A (TOUPURE K.K.) 21 June 2022 (2022-06-21) paragraphs [0025], [0041], [0044], [0047], fig. 1, 6, 16, 18	1-2
A		3
A	WO 2014/148618 A1 (NIPPON STEEL & SUMITOMO METAL CORP.) 25 September 2014 (2014-09-25) entire text, all drawings	1-3
A	WO 2022/049916 A1 (JFE STEEL CORP.) 10 March 2022 (2022-03-10) entire text, all drawings	1-3
A	WO 2019/216317 A1 (NIPPON STEEL CORP.) 14 November 2019 (2019-11-14) entire text, all drawings	1-3
A	WO 2016/194963 A1 (NIPPON STEEL & SUMITOMO METAL CORP.) 08 December 2016 (2016-12-08) entire text, all drawings	1-3

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

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"P" document published prior to the international filing date but later than the priority date claimed	

Date of the actual completion of the international search	Date of mailing of the international search report
14 July 2023	01 August 2023
Name and mailing address of the ISA/JP	Authorized officer
Japan Patent Office (ISA/JP) 3-4-3 Kasumigaseki, Chiyoda-ku, Tokyo 100-8915 Japan	Telephone No.

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INTERNATIONAL SEARCH REPORT
Information on patent family members

International application No.

PCT/JP2023/019071

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JP 2022-91379 A	21 June 2022	(Family: none)	
WO 2014/148618 A1	25 September 2014	US 2015/0367392 A1 entire text, all drawings EP 2977120 A1 KR 10-2015-0113052 A CN 105188980 A MX 2015010365 A RU 2015134140 A BR 112015019694 A	
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REFERENCES CITED IN THE DESCRIPTION

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- WO 2019216317 A [0008]
- WO 2022049916 A [0008]
- WO 2016194963 A [0008]