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(54) **PLATED STEEL SHEET, AND APPARATUS AND METHOD FOR MANUFACTURING SAME**

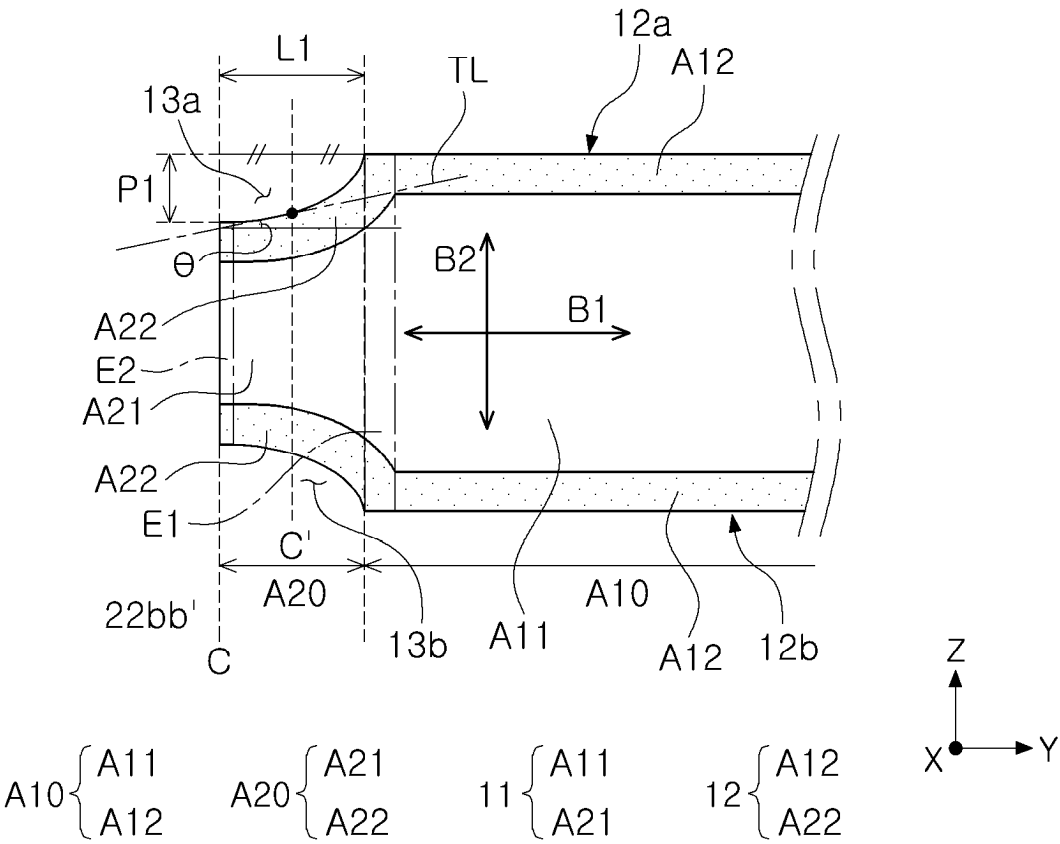
(57) An embodiment of the present invention provides a plated steel sheet comprising: a first plated steel sheet region extending in a first direction and including a first steel sheet region and a first plated region; and a second plated steel sheet region extending in the first direction and including a second steel sheet region and a second plated region, wherein the second plated steel sheet region includes: a first end portion that is continuous with the first plated steel sheet re-

gion; a second end portion formed in a direction opposite to the first end portion; a pressed portion pressed inwardly from the upper surface or the lower surface of the second plated region by a press depth in the second direction; and a cut portion disposed in the second end portion of the second plated steel sheet region and extending in the second direction, wherein the width of the second plated steel sheet region is greater than the press depth.

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[FIG. 2]

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Description

Technical Field

[0001] The present disclosure relates to a plated steel sheet, and an apparatus and method for manufacturing the same.

Background Art

[0002] In a process of cutting a plated steel sheet, a straight blade is used. When cutting is performed using such a straight blade, as a technique for preventing corrosion of a cut surface, there may be provided a technique in which an improved blade is configured such that, when cutting a plated steel sheet, a plating layer is pushed down to adhere to a cut surface in a small amount so as to delay corrosion of the cut surface, a technique in which, when cutting a plated steel sheet, upper and lower blades are disposed to be positioned on a vertical line of the steel sheet so that the plating layer can be pushed down onto the cut surface, and so on. However, such techniques may be utilized to improve corrosion resistance of a cut surface of a plated steel sheet in a sheet form, but have a limitation in that they are not easily applicable to a cut surface of a plated steel sheet in a coil form. Further, when a blade having a circular shape instead of a straight shape is used for cutting a plated steel sheet in a coil form, there are disadvantages in that, compared to a conventional blade, a lifespan of the blade is shortened, and a cut surface is not clean and becomes rough, thereby promoting corrosion.

[0003] Meanwhile, in the cut surface of the plated steel sheet, a sacrificial corrosion protection of the plating layer plays a key role in corrosion prevention. In addition, the plating layer reacts with corrosion-causing substances to generate corrosion products. Such corrosion products flow down to the cut surface of the plated steel sheet by water droplets formed on the surface of the plating layer or by rainfall, and are accumulated on portions where corrosion has occurred, thereby also performing a corrosion prevention function by a barrier mode.

[0004] The sacrificial corrosion protection and the barrier mode at the cut surface of the plated steel sheet are improved as a thickness of the plated steel sheet decreases and as a thickness of the plating layer increases. When the corrosion resistance performance of the cut surface of the plated steel sheet is improved, a lifespan of a component is also increased. However, since thickness of a plated steel sheet needs to be maintained to secure rigidity depending on use of the plated steel sheet, the thickness cannot be reduced to a certain level or less, and there is also a problem that, since a plating amount has a limitation in a manufacturing process of the plated steel sheet, it is not easy to perform plating at a certain plating amount or more.

Summary of Invention

Technical Problem

[0005] An aspect of the present disclosure is to provide a plated steel sheet capable of suppressing generation of rust on a cut surface by reducing a thickness of the plated steel sheet and minimizing an area of a steel sheet exposed through the cut surface, and an apparatus and method for manufacturing the same.

Solution to Problem

[0006] According to an aspect of the present disclosure, a plated steel sheet includes: a first plated steel sheet region extending in a first direction and including a first steel sheet region and a first plated region; and a second plated steel sheet region extending in the first direction and including a second steel sheet region and a second plated region, in which the second plated steel sheet region includes: a first end portion continuous with the first plated steel sheet region; a second end portion formed in a direction opposite to the first end portion; a pressed portion pressed inwardly from an upper surface or a lower surface of the second plated region by a pressing depth in the second direction; and a cut portion disposed in the second end portion of the second plated steel sheet region and extending in the second direction, and in which a width of the second plated steel sheet region is greater than the pressing depth.

[0007] The pressed portion may have the pressing depth that changes along the first direction.

[0008] The pressing depth of the pressed portion may increase from the first end portion of the second plated steel sheet region toward the second end portion along the first direction.

[0009] The pressed portion may have a curved shape toward an inner side of the second plated steel sheet region.

[0010] A slope of a tangent line of the pressed portion may change along the first direction between the first end portion and the second end portion of the second plated steel sheet region.

[0011] An average slope of the tangent line between a center of the first end portion and the second end portion of the second plated steel sheet region and the second end portion may be 45° or less.

[0012] The pressed portion may have a minimum radius of curvature at the second end portion of the second plated steel sheet region and a maximum radius of curvature at the first end portion of the second plated steel sheet region.

[0013] The minimum radius of curvature may be 0.25 mm.

[0014] A thickness of the second plated steel sheet region may be 10% to 90% of that of the first plated steel sheet region.

[0015] The second plated region may have a first thickness at the first end portion of the second plated steel sheet region, and have a second thickness less than or equal to the first thickness at the second end portion of the second plated steel sheet region.

[0016] The plated steel sheet may further include a third plated region extending in the second direction and at least partially covering the cut portion.

[0017] The third plated region may have a thickness smaller than the second plated region.

[0018] The third plated region may have a smaller plating amount than the second plated region.

[0019] The second plated region may have greater density than the first plated region.

[0020] The second steel sheet region may have greater density than the first steel sheet region.

[0021] A width of the pressed portion is 0.25 mm to 4 mm.

[0022] The second plated steel sheet region may have a first pressed portion that is concave downward from the upper surface of the second plated region, and a second pressed portion that is disposed to face the first pressed portion and is concave upward from the lower surface of the second plated region.

[0023] According to another aspect of the present disclosure, a method for manufacturing a plated steel sheet includes: supplying a plated steel sheet including a first plated steel sheet region that includes a first plated region and a first steel sheet region; forming a second plated steel sheet region, extending in a first direction and includes a second plated region and a second steel sheet region, by press-forming the plated steel sheet; and forming a cut portion extending in a second direction in the second plated steel sheet region.

[0024] In the forming of the second plated steel sheet region, a pressed portion may be formed to be concave toward an inner side of the second plated region along the second direction and have a width greater than a pressing depth.

[0025] Press pressure applied to the second plated region may have 5 kg/cm² to 300 kg/cm².

[0026] In the forming of the cut portion, the cut portion may be formed to pass through a center of the pressed portion.

[0027] In the forming of the cut portion, a third plated region may further be formed that extends along the second direction and at least partially covers the cut portion. Advantageous Effects of Invention

[0028] According to a plated steel sheet according to an aspect of the present disclosure, by press-forming a cutting target location to reduce a thickness and then cutting a press-formed portion, it is possible to minimize an area of a steel sheet exposed externally by a cutting process. Therefore, by delaying the time at which rust occurs on the cut portion, it is possible for the plated steel sheet to retain improved corrosion resistance

even after being cut.

[0029] In addition, since the pressed portion may be formed in the plated steel sheet in the inwardly curved shape during the press-forming, it is possible to prevent damage, such as damage or peeling of the plating layer, from occurring during the press-forming process compared to a case where a conventional sharp-shaped structure is used. Furthermore, by applying pressure using a curved pressing portion corresponding to the pressed portion during the press-forming, it is possible to prevent a portion in which the thickness and plating amount are sharply reduced from being formed at the pressed portion, thereby further improving the corrosion resistance of the plated steel sheet.

Brief Description of Drawings

[0030]

FIG. 1 is a perspective view of a portion of a plated steel sheet according to an embodiment of the present disclosure.

FIG. 2 is a cross-sectional view of the plated steel sheet of FIG. 1 viewed from the side.

FIG. 3 is a cross-sectional view of the plated steel sheet of FIG. 1 viewed from the side.

FIG. 4 is a cross-sectional view of a portion of a plated steel sheet according to another embodiment of the present disclosure viewed from the side.

FIG. 5a is a lateral cross-sectional view of a portion of a plated steel sheet before a cutting process according to still another embodiment of the present disclosure.

FIG. 5b is a lateral cross-sectional view of the plated steel sheet of FIG. 5a subjected to the cutting process.

FIG. 6 is a diagram schematically illustrating a stage in which an apparatus for manufacturing a plated steel sheet according to the present disclosure has not yet press-formed the plated steel sheet.

FIG. 7 is a diagram schematically illustrating a stage in which the apparatus for manufacturing a plated steel sheet according to an embodiment of the present disclosure press-forms the plated steel sheet.

FIG. 8 is a diagram schematically illustrating a stage in which an apparatus for manufacturing a plated steel sheet according to another embodiment of the present disclosure press-forms the plated steel sheet.

FIG. 9 is a diagram illustrating a pressing portion of a pressing unit according to an embodiment of the present disclosure, in which the lower enlarged view of FIG. 9 illustrates a pressing portion according to another embodiment of the present disclosure.

FIG. 10a is a diagram illustrating a pressing portion of another pressing unit of the present disclosure.

FIG. 10b is a diagram illustrating a pressing portion of another pressing unit of the present disclosure.

FIG. 11 is a cross-sectional view illustrating the plated steel sheet before being cut after the press-forming is completed.

FIG. 12 is a diagram schematically illustrating a stage in which the apparatus for manufacturing a plated steel sheet according to another embodiment of the present disclosure has not yet press-formed the plated steel sheet.

FIG. 13 is a diagram schematically illustrating a stage in which a steel sheet processing apparatus of FIG. 11 press-forms the plated steel sheet.

FIG. 14a is a diagram illustrating a state of the plated steel sheet before a cutting process.

FIG. 14b is a diagram illustrating the plated steel sheet with a cut portion formed by the cutting process.

FIG. 15 is a diagram schematically illustrating a state of the plated steel sheet according to the present disclosure after completion of the cutting process and before the press-forming.

FIG. 16 is a cross-sectional view of an enlarged portion of a plated steel sheet manufactured after the completion of the cutting process and press-forming.

Mode for Invention

[0031] Hereinafter, embodiments will be described in detail with reference to the accompanying drawings so that they can be easily practiced by those skilled in the art to which the present invention pertains. However, in describing exemplary embodiments of the present invention, detailed descriptions of well-known functions or constructions will be omitted so as not to obscure the description of the present invention with unnecessary detail. In addition, like or similar reference numerals denote parts performing similar functions and actions throughout the drawings. In addition, in this specification, the terms such as "top," "upper portion," "upper surface," "bottom," "lower portion," "lower surface," and "side surface" are based on the drawings and may vary depending on a direction in which components are arranged in practice.

[0032] A case in which any one part is connected with the other part includes a case in which the parts are directly connected with each other and a case in which the parts are indirectly connected with each other with other components interposed therebetween. In addition, a phrase 'including any component' will be understood to imply the inclusion of other components rather than the exclusion of other component, unless explicitly described otherwise.

[0033] FIG. 1 is a perspective view of a portion of a plated steel sheet according to an embodiment of the

present disclosure.

[0034] Referring to FIG. 1, a plated steel sheet 10 according to an embodiment of the present disclosure (hereinafter, Embodiment 1) may include a steel sheet 11 and a plating layer 12. The steel sheet 11 may have a long plate shape.

[0035] For example, the plated steel sheet 10 may be manufactured by forming the plating layer 12 on the steel sheet 11, press-forming a portion of the plating layer 12, and then cutting the plated steel sheet 10 to a predetermined length. As another example, the plated steel sheet 10 may be manufactured by forming the plating layer 12 on the steel sheet 11, cutting the plated steel sheet 10 to a predetermined length, and then press-forming the cut portion (hereinafter, cut portion) 14. In this case, the plated steel sheet 10 may be cut into various lengths based on the use of the plated steel sheet 10, etc.

[0036] The plating layer 12 may be formed on the steel sheet 11. In this case, the plating layer 12 may partially wrap an outer surface of the steel sheet 11, thereby improving the corrosion resistance and durability of the steel sheet 11.

[0037] For example, zinc may be used as a plating material for forming the plating layer 12. Additionally, a small amount of aluminum and magnesium may be added to zinc to form the plating layer 12. In this case, the plating layer 12 may be composed to contain 10% to 15% aluminum, 4% to 6% magnesium, and 79% to 86% zinc, but is not limited thereto. Meanwhile, the plating layer 12 may be formed by methods such as electroplating or hot-dip plating.

[0038] The plating layer 12 may include a first plating portion 12a covering an upper surface of the steel sheet 11 and a second plating portion 12b covering a lower surface of the steel sheet 11. Accordingly, the plating layer 12 may be formed on the upper surface and the lower surface of the steel sheet 11. According to an embodiment, the plating layer 12 may not be formed on a side surface portion 11a of the steel sheet 11. According to another embodiment, the plating layer 12 may be partially formed by extending a portion of the side surface portion 11a of the steel sheet 11.

[0039] FIG. 2 illustrates the plated steel sheet of FIG. 1 viewed from the side.

[0040] Referring to FIG. 2, the plated steel sheet 10 may include a first plated steel sheet region A10 and a second plated steel sheet region A20.

[0041] The first plated steel sheet region A10 may include a first steel sheet region A11 and a first plated region A12.

[0042] The first steel sheet region A11 may be in the form of a plate extending in a first direction B1 to have the same or similar thickness. In this case, the first steel sheet region A11 may include a portion of a steel sheet A21 whose thickness has been reduced by the press-forming. In this case, a portion of the steel sheet A21 whose thickness has been reduced may be dis-

posed in a portion connected to the second steel sheet region A21 to be described later.

[0043] The first plated region A12 is a region where the press-forming is not directly performed in the plating layer 12, and may be formed on the first steel sheet region A11. More specifically, the first plated region A12 may cover an upper surface and a lower surface of the first steel sheet region A11. In this case, the first plated region A12 may not be formed on both side surface portions 11a of the first steel sheet region A11, or a portion thereof may be formed.

[0044] The second plated steel sheet region A20 is a region of the plated steel sheet 10 where the press-forming is performed, and may be arranged to be continuous with the first plated steel sheet region A10. More specifically, a first end portion E1 of the second plated steel sheet region A20 may be continuous with the first plated steel sheet region A10. A second end portion E2 of the second plated steel sheet region A20 may be formed in a region extended to an opposite side of the first plated steel sheet region A10 along the first direction B1. Here, the first direction B1 is a width direction of the plated steel sheet 10 and may be a direction parallel to a Y-axis direction of the drawing. A cut portion 14 is formed in the second end portion E2 of the second plated steel sheet region A20, which will be described later.

[0045] The second plated steel sheet region A20 may include a second steel sheet region A21 and a second plated region A22. The second plated region A22 may be formed on an upper surface and a lower surface of the second steel sheet region A21. In this case, the second plated region A22 may not be formed on both side surface portions 11a of the second steel sheet region A21, or only a portion thereof may be formed.

[0046] The second plated steel sheet region A20 may include a pressed portion 13 and the cut portion 14. The pressed portion 13 may be formed by the above-described press-forming. The pressed portion 13 may be in a shape that is concave inwardly on one surface of the second plated region A22. The above-described one surface of the second plated region A22 may be either an upper surface or a lower surface of the second plated region A22. Accordingly, the pressed portion 13 may be concavely formed inwardly by a pressing depth P1 along a second direction B2 from the upper and lower surfaces of the second plated region A22. Here, the second direction B2 is a thickness direction of the plated steel sheet 10 and may be a direction parallel to a Z-axis direction of the drawing.

[0047] The pressing depth P1 may vary along the width direction (i.e., the first direction) B1 of the pressed portion 13. More specifically, the pressing depth P1 may increase from the first end portion E1 of the second plated steel sheet region A20 toward the second end portion E2 along the first direction B1. In this case, the pressing depth P1 of the pressed portion

13 may be minimum at the first end portion E1 and maximum at the second end portion E2. For example, the pressed portion 13 may have a curved shape toward an inner side of the second plated steel sheet region A20. In this case, when viewed from the side direction (e.g., the YZ plane direction), the pressed portion 13 may extend in a curved shape along the first direction B1. In this case, a width L1 of the pressed portion 13 may be formed to be greater than the pressing depth P1. Accordingly, the curved pressed portion 13 may have a minimum radius of curvature at the second end portion E2 of the second plated steel sheet region A20 and a maximum radius of curvature at the first end portion E1 of the second plated steel sheet region A20. In this case, the minimum radius of curvature may be, for example, 0.25 mm. In this case, the radius of curvature of the pressed portion 13 may be greater than or equal to 0.25 mm. Due to being formed in the curved shape, a slope θ of a tangent line TL of the pressed portion 13 may vary along the first direction B1. More specifically, the slope θ of the tangent line TL may be minimized at the second end portion E2 of the second plated steel sheet region A20 where the pressing depth P1 is maximum. In this case, the slope θ of the tangent line TL may gradually increase along the first direction B1 toward the first end portion E1 of the second plated steel sheet region A20. Accordingly, the slope θ of the tangent line TL may be maximized at the first end portion E1 of the second plated steel sheet region A20 where the pressing depth P1 is minimum. In this case, the slope of the tangent line TL from a center C' of the pressed portion 13 with respect to the first direction B1 may have a size between the maximum slope and the minimum slope described above. In this case, the pressed portion 13 may be formed such that an average slope of the tangent line TL from the second end portion E2 of the second plated steel sheet region A20 to the center C' of the pressed portion 13 is 45° or less.

[0048] The second plated steel sheet region A20 may include two pressed portions 13. In this case, one (hereinafter, the first pressed portion) 13a of the two pressed portions 13 may be concavely formed downwardly from the upper surface of the second plated region A22. The other one (hereinafter, the second pressed portion) 13b of the two pressed portions 13 may be concavely formed upwardly from the lower surface of the second plated region A22. In this case, the first pressed portion 13a and the second pressed portion 13b may be arranged to face each other along the second direction B2.

[0049] Meanwhile, for convenience of description, although the directions in which the first pressed portion 13a and the second pressed portion 13b are recessed are opposite, the description is given focusing on a case in which the shapes and sizes are identical, but the present disclosure is not limited thereto.

[0050] The cut portion 14 may be formed by cutting a

cutting target portion (see CP in FIG. 6) of the plated steel sheet 10 along a cutting direction. In this case, the cutting direction may be a direction parallel to the second direction B2.

[0051] For example, the cut portion 14 may be formed by cutting pressed portions (13AA, 13BB in FIG. 8) after completion of the press-forming. For example, the cut portion 14 may be formed by cutting along a direction parallel to the second direction B2, passing through a center C of the pressed portion (13AA, 13BB in FIG. 9) before cutting. In addition, when two pressed portions 13 are provided, the cut portion 14 may be formed by cutting along a direction parallel to the second direction B2, passing through the common center C of the first pressed portion 13AA before cutting and the second pressed portion 13BB before cutting. By cutting in this way, the cut portion 14 may be disposed in the second end portion E2 of the second plated steel sheet region A20 in the plated steel sheet 10 after completion of the cutting process.

[0052] Additionally, when viewed from the side (e.g., ZX plane direction) along the first direction B1, the steel sheet 11 may be disposed in a center region 14a of the cut portion 14. The plating layer 12 may be disposed in a border region 24b surrounding the center region 14a of the cut portion 14. Through the center region 14a of the cut portion 14, a portion of the second steel sheet region A21 may be exposed externally

[0053] As another example, the cut portion 14 may be formed before the pressed portion 13. In this case, once the cutting process for the plated steel sheet 10 is completed, the press-forming may be performed around the formed cut portion 14. By doing so, the pressed portion 13 may be formed. In this case, since the specific features of the pressed portion 13 and the cut portion 14 are identical or similar to those described above, redundant descriptions will be omitted.

[0054] FIG. 3 is a cross-sectional view of the plated steel sheet of FIG. 1 viewed from the side.

[0055] Referring to FIG. 3, the thickness of the second plated steel sheet region A20 may be less than or equal to a thickness T1 of the first plated steel sheet region A10. As the pressed portion 13 is formed in the second plated steel sheet region A20 in which the pressing depth P1 changes along the first direction B1, the thickness of the second plated steel sheet region A20 may also vary along the first direction B1.

[0056] More specifically, the second plated steel sheet region A20 may have a maximum thickness at the first end portion E1. The thickness of the second plated steel sheet region A20 gradually decreases as the second plated steel sheet region A20 moves toward the second end portion E2 along the first direction B1, so that the second plated steel sheet region A20 may have a minimum thickness $2T2a + T3a$ at the second end portion E2. In this case, the maximum thickness of the second plated steel sheet region A20 may be equal to the thickness T1 of the first plated steel sheet region

A10. Accordingly, the thickness of the second plated steel sheet region A20 between the first end portion E1 and the second end portion E2 may be smaller than the thickness T1 of the first plated steel sheet region A10.

The thickness (i.e., minimum thickness) of the second plated steel sheet region A20 at the second end portion E2 may be 10% to 90% of the thickness T1 of the first plated steel sheet region A10.

[0057] Additionally, during the press-forming, the steel sheet 11 may be pressed along with the plating layer 12 so that its thickness may be reduced. In this case, the first steel sheet region A11 may have a minimum thickness T3a at the second end portion E2 where the pressing depth P1 is maximum. In this case, the above-described second end portion E2 is the portion where the cut portion 14 is formed, so that the thickness T3a of the first steel sheet region A11 in the cut portion 14 is minimized. As a result, the area of the steel sheet 11 exposed externally through the cut portion 14 may be minimized.

[0058] The width of the second plated steel sheet region A20 may be greater than the above-described pressing depth P1 of the pressed portion 13. In this case, the width of the second plated steel sheet region A20 may be equal to the width L1 of the pressed portion 13. Accordingly, the pressed portion 13 may have a shape in which the width L1 is greater than the pressing depth P1. In this case, the width L1 of the pressed portion 13 may be, for example, 0.25 mm to 4 mm.

[0059] As described above, since the press-forming is performed only on the second plated steel sheet region A20, the second plated region A22 may have greater density than the first plated region A12. This may be the result of the press-forming being performed on only the second plated region A22, which is a portion of the plating layer 12 having the same or similar thickness before press-forming, so that the second plated region A22 is pressed into the interior of the plated steel sheet 10 along the vertical direction Z.

[0060] Additionally, during the press-forming, a portion of the steel sheet 11 corresponding to the second steel sheet region A21 is pressed together, so the second steel sheet region A21 may have greater density than the first steel sheet region A11.

[0061] The thickness of the second plated region A22 formed by the press-forming may be thinner than the thickness T2 of the first plated region A12 that is not pressed. As described above, the slope θ of the tangent line TL and the radius of curvature of the second end portion E2 of the second plated steel sheet region A20 are minimized by the curved pressed portion 13, so the second plated region A22 may maintain a predetermined thickness T2a at the second end portion E2. That is, by press-forming the pressed portion 13 into the curved shape, the plating layer 12 at the second end portion E2 of the second plated steel sheet region A20 may be prevented from being damaged or peeled off during the pressing process.

[0062] The thickness of the second plated region A22 may, for example, have the same or similar thickness overall along the longitudinal direction (first direction) B1 of the second plated region A22, but the present disclosure is not limited thereto. As another example, the thickness of the second plated region A22 at the second end portion E2 may be smaller than that at the first end portion E1 (first thickness). According to an embodiment, the second plated region A22 has a maximum thickness at the first end portion E1 and decreases slightly along the first direction B1 toward the second end portion E2, so the thickness T2a at the second end portion E2 may be minimized. In this case, the density of the second plated region A22 is maximum at the second end portion E2 where the thickness is minimized, and the density may be minimized at the first end portion E1 having the maximum thickness.

[0063] FIG. 4 is a cross-sectional view of a portion of a plated steel sheet according to another embodiment of the present disclosure viewed from the side.

[0064] Referring to FIG. 4, a plated steel sheet 10A according to another embodiment (hereinafter, Embodiment 2) of the present disclosure may include a first plated steel sheet region A10 and a second plated steel sheet region A20. Since the specific features of these are identical or similar to those of the above-described Embodiment 1, a redundant description thereof will be omitted. Additionally, the plated steel sheet 10A according to Embodiment 2 may further include a third plated region A30.

[0065] The third plated region A30 may be disposed in the cut portion 14. The third plated region A30 may be formed to cover at least partially the cut portion 14. In this case, the third plated region A30 may be continuous with the second plated region A22 and extend along the second direction B2.

[0066] As the pressed portion 13 is formed at the top and bottom of the second plated steel sheet region A20, respectively, the plated steel sheet 10A may include two third plated regions A30. In this case, based on the second direction B2, a third plated region (hereinafter referred to as an upper third plated region) A31 disposed on the upper side may be connected to the second plated region (hereinafter referred to as the upper second plated region) A22 disposed on an upper end portion of the second plated steel sheet region A20. More specifically, the upper end portion of the upper third plated region A31 is connected to the upper second plated region A22, and the lower end portion of the upper third plated region A31 may extend downwardly along the second direction B2. In this case, based on the second direction B2, a third plated region (hereinafter referred to as a lower third plated region) A32 disposed on the lower side may be connected to the second plated region (hereinafter referred to as the lower second plated region) A22 disposed on a lower end portion of the second plated steel sheet region A20. More specifically, the lower end portion of the low-

er third plated region A32 is connected to the lower second plated region A22, and the upper end portion of the lower third plated region A32 may extend upwardly along the second direction B2.

[0067] The upper third plated region A31 and the lower third plated region A32 may be connected to each other, for example. In this case, the lower end portion of the upper third plated region A31 and the upper end portion of the lower third plated region A32 may be connected so that they are at least partially continuous. As another example, the lower end portion of the upper third plated region A31 and the upper end portion of the lower third plated region A32 may be spaced apart from each other.

[0068] The third plated region A30 described above may be formed by the movement of a portion of the plating component contained in the second plated region A22 during the cutting process of the plated steel sheet 10. Accordingly, the second plated region A30 may have a smaller plating amount than the second plated region A20. Additionally, the thickness of the third plated region A30 may be smaller than that of the second plated region A22. In this case, the thickness of the upper third plated region A31 may decrease from the top to the bottom, but as another example, the upper third plated region A31 may be formed to have the same or similar thickness overall along the second direction B2. In addition, the thickness of the lower third plated region A32 may decrease from the bottom to the top, but as another example, the lower third plated region A32 may be formed to have the same or similar thickness overall along the second direction B2.

[0069] FIG. 5a is a lateral cross-sectional view of a portion of a plated steel sheet before a cutting process according to still another embodiment of the present disclosure. FIG. 5b is a lateral cross-sectional view of the plated steel sheet of FIG. 5a subjected to the cutting process.

[0070] Referring to FIGS. 5a and 5b, the plated steel sheet 10B according to another embodiment (hereinafter, Embodiment 4) of the present disclosure may include the first plated steel sheet region A10 and the second plated steel sheet region A20. In this case, since the specific features of the first plated steel sheet region A10 are identical or similar to those of Embodiment 1 described above, redundant descriptions will be omitted, and the following description will focus on the differences.

[0071] As illustrated in FIG. 5a, after the press-forming is completed, the pressed portion 13AA may be formed only in an upper end portion of a plated steel sheet 10B. In this case, the pressed portion 13AA is the pressed portion before cutting and may have a wider width 2L1 than the pressed portion 13 after the completion of the cutting process. In this case, a lower end portion of the plated steel sheet 10B may be in a flat shape where the press-forming is not performed.

[0072] In the case of the plated steel sheet 10B after

the completion of the cutting process, as illustrated in FIG. 5b, one pressed portion 13 may be included in the second plated steel sheet region A20. In this case, because only one pressed portion 13 is formed, the cut portion 14A may have a thickness T3A different from that of Embodiment 1 or Embodiment 2. In addition, the area of the second steel sheet region A21 exposed externally through the cut portion 14A may also differ from that of Embodiment 1 or Embodiment 2. However, in the case of the plated steel sheet 10A according to Embodiment 3, a pressed portion 13 having an inwardly curved shape is formed in the second plated steel sheet region A20, thereby reducing the area of the steel sheet 11 exposed externally after the cutting process and delaying the time of rust to occur in the cut portion 14A, as in the previous embodiment.

[0073] Meanwhile, in the above-described examples, for convenience of description, each region of the plated steel sheets 10, 10A, and 10B was referred to separately; however, the first plated steel sheet region A10 and the second plated steel sheet region may refer to each region of a single plated steel sheets 10, 10A, and 10B.

[0074] FIG. 6 is a diagram schematically illustrating a stage in which an apparatus for manufacturing a plated steel sheet according to the present disclosure has not yet press-formed the plated steel sheet. FIG. 7 is a diagram schematically illustrating a stage in which the apparatus for manufacturing a plated steel sheet according to an embodiment of the present disclosure press-forms the plated steel sheet. FIG. 8 is a diagram schematically illustrating a stage in which an apparatus for manufacturing a plated steel sheet according to another embodiment of the present disclosure press-forms the plated steel sheet. FIG. 9 is a diagram illustrating a pressing portion of a pressing unit according to an embodiment of the present disclosure, in which the lower enlarged view of FIG. 9 illustrates a pressing portion according to another embodiment of the present disclosure. FIG. 10a is a diagram illustrating a pressing portion of another pressing unit of the present disclosure. FIG. 10b is a diagram illustrating a pressing portion of another pressing unit of the present disclosure. FIG. 11 is a cross-sectional view illustrating the plated steel sheet before being cut after the completion of the press-forming.

[0075] Referring to FIGS. 6 to 11, the apparatus 20 for manufacturing a plated steel sheet may press-form a portion of the plated steel sheet 10 before the cutting process of the plated steel sheet 10. By doing so, the pressed portion 13 may be formed. Hereinafter, for convenience of description, the description will focus on the case where the apparatus 20 for manufacturing a plated steel sheet manufactures the plated steel sheet 10 according to Embodiment 1, but is not limited thereto.

[0076] The plated steel sheet 10 to be press-formed may be formed by including the steel sheet 11 and the

plating layer 12a and 12b that wraps around an outer surface of the steel sheet 11. For example, the plated steel sheet 10 is a ternary plated steel sheet. In this case, the plating layer 12a and 12b may contain 10 to 15% aluminum, 4 to 6% magnesium, and 79 to 86% zinc, but is not limited thereto.

[0077] An apparatus 20 for manufacturing a plated steel sheet according to an embodiment (hereinafter, Embodiment 1) of the present disclosure may include a pair of pressing units 100 and 200. Hereinafter, one of the pair of pressing units will be referred to as the first pressing unit 100, and the other of the pair of pressing units will be referred to as the second pressing unit 200.

[0078] The first pressing unit 100 and the second pressing unit 200 may be disposed to face each other. For example, when press-forming the plated steel sheet 10, the first pressing unit 100 and the second pressing unit 200 may be disposed symmetrically to each other with respect to the plated steel sheet 10. In this case, the first pressing unit 100 may be disposed on the upper side of the plated steel sheet 10, and the second pressing unit 200 may be disposed on the lower side of the plated steel sheet 10.

[0079] At least one of the first pressing unit 100 and the second pressing unit 200 may be configured to be movable up and down. For example, both the first pressing unit 100 and the second pressing unit 200 may be movable up and down. In this case, the pressing units 100 and 200 may move toward each other or away from each other in a vertical direction, with the plated steel sheet 10 interposed therebetween. As another example, either the first pressing unit 100 or the second pressing unit 200 may be configured to be movable up and down. In this case, either the pressing units 100 and 200 may be fixed while the other of the pressing units 100 and 200 may move up and down. For convenience of explanation, the following description will focus on the case where both the pressing units 100 and 200 are configured to be movable up and down.

[0080] The first pressing unit 100 may be provided with a body (hereinafter, a first body) 110, a connecting portion (hereinafter, a first connecting portion) 120, and a pressing portion (hereinafter, a first pressing portion) 130.

[0081] The first body 110 is a portion where other components of the first pressing unit 100 are installed and supported, and may be connected to a driving unit (not illustrated). The first body 110 may move up and down along a first lifting direction D1 using the driving force provided by the driving unit.

[0082] The first body 110 may have various shapes. More specifically, the first body 110 may be in a shape that extends along a first direction A1. In this case, the first direction A1 may be a direction (or a left-right direction in the drawing) parallel to a floor surface of a building where the apparatuses 20 and 20A for manufactur-

ing a plated steel sheet is installed, but is not limited thereto. For example, the first body 110 may be formed in a cylindrical shape that extends along the first direction A1.

[0083] The first connecting portion 120 may be coupled to the first body 110. In this case, the first connecting portion 120 may be formed in a shape that extends along a second direction A2 that is different from the first direction A1, which is the extension direction of the first body 110. Although the drawing illustrates the second direction A2 as being perpendicular to the first direction A1, this is merely one embodiment, and it is obvious that the second direction A2 may be a diagonal direction inclined at a predetermined angle with respect to the first direction A1. However, for convenience of description, the description will be made mainly based on a case in which the second direction A2 is perpendicular to the first direction A1. In this case, the second direction A2 may be a direction parallel to the first lifting direction D1 described above.

[0084] The first connecting portion 120 may have a length longer than the thickness of the first body 110. Accordingly, both end portions (upper end portion and lower end portion) of the first connecting portion 120 may protrude from the first body 110 with respect to the first lifting direction D1. More specifically, the first connecting portion 120 may protrude outwardly from an outer surface of the first body 110. Additionally, the first connecting portion 120 may be formed in a shape that wraps around the outer surface along the circumferential direction of the first body 110. For example, when the first body 110 is cylindrical, the first connecting portion 120 may be formed in a ring or a similar shape that extends along the circumferential direction of the first body 110 and wraps around the outer surface of the first body 110. The first pressing portion 130 may be a portion that directly presses the upper surface of the plated steel sheet 10 during the press-forming. The first pressing portion 130 may be disposed on the first connecting portion 120. In this case, the first pressing portion 130 may be in a form that protrudes outwardly from the outer surface of the first connecting portion 120. The end portion of the first pressing portion 130 that protrudes outwardly as described above shall be referred to as a first outer end portion 130a.

[0085] The first pressing portion 130 may wrap around the outer surface of the first connecting portion 120. More specifically, the first pressing portion 130 may extend along a circumferential direction of the first connecting portion 120 so as to wrap around the outer surface of the first connecting portion 120. In this case, the first pressing portion 130 may extend in the circumferential direction of the first connecting portion 120 described above, and may be in the shape of a ring where the two end portions meet each other. Accordingly, the first outer end portion 130a may also extend along the circumferential direction of the first connecting portion 120 while protruding outwardly from the first

connecting portion 120.

[0086] For example, the first pressing portion 130 may be provided as a separate component from the first connecting portion 120 and fixedly coupled to the first connecting portion 120, or as another example, the first pressing portion 130 may be in the form of a protrusion formed integrally with the first connecting portion 120.

[0087] The first outer end portion 130a of the first pressing portion 130 may have a shape that is at least partially rounded. More specifically, the first outer end portion 130a may be in the shape of a hemisphere with a circular cross-section. Accordingly, the lower surface 131a of the first outer end portion 130a may be curved in shape with a constant curvature overall.

[0088] A width L2 of the first pressing portion 130 may be smaller than that of the first connecting portion 120. In this case, the outer surface of the first connecting portion 120 may be in a shape parallel to a longitudinal direction (first direction) A1 of the plated steel sheet 10. Accordingly, when viewing the apparatus 20 for manufacturing a plated steel sheet from the side, as illustrated in FIG. 9, the first outer end portion 130a in the shape of the hemisphere may be provided in a form protruding outwardly from the central portion of the outer surface of the first connecting portion 120 that extends parallel to the first direction A1. Meanwhile, the width L2 of the first pressing portion 130 may be, for example, 0.5 mm to 8 mm, but it is obvious that this may be changed depending on the purpose of use of the plated steel sheet 10.

[0089] In another embodiment, the first pressing portion 130 may further have a protrusion 132a on the first outer end portion 130a, as illustrated exemplarily in the lower drawing of FIG. 9. In this case, the protrusion 132a may protrude further outwardly from the outer surface 131a of the first outer end portion 130a. The protrusion 132a may be formed to extend along the circumferential direction of the first pressing portion 130 to wrap around the above-described outer surface 131a of the first pressing portion 130. In this case, the protrusion 132a may have a hemispherical cross-section having a diameter smaller than the width L2 of the first pressing portion 130. In this way, by having a multi-stage structure in which the first pressing portion 130 includes the first outer end portion 130a and the protrusion 132a, the plated steel sheet 10 may be pressed to a deeper depth. By doing so, the thickness of the pressed portion of the plated steel sheet 10 (see T3 in FIG. 10) may be further reduced. Additionally, the protrusion 132a may be formed with a narrower width than the first outer end portion 130a. By cutting the pressed portion with such a narrow width, the area of the steel sheet 11 exposed externally by the cutting process may be minimized.

[0090] The plurality of first pressing portions 130 may be provided. In this case, the plurality of first connecting portions 120 on which the first pressing portions 130

are disposed may also be provided in the same number as the first pressing portions 130. In this case, the first connecting portion 120 and the first pressing portion 130 disposed therein may be spaced apart at predetermined intervals along the longitudinal direction of the first body 110. For example, the distance between adjacent first pressing portions 130 may be equal. However, since the distance between the first pressing portions 130 corresponds to the length of the plated steel sheet 10 after cutting, it may be changed according to the purpose of use of the cut plated steel sheet 10.

[0091] The second pressing unit 200 may be disposed to face the first pressing unit 100. Accordingly, when the plated steel sheet 10 is fed between the first pressing unit 100 and the second pressing unit 200, it may be pressed by the first pressing unit 100 and the second pressing unit 200.

[0092] The second pressing unit 200 may be equipped with a body (hereinafter, a second body) 210, a connecting portion (hereinafter, a second connecting portion) 220, and a pressing portion (hereinafter, a second pressing portion) 230. Since the specific features of these are identical or similar to those of the first pressing unit 100 described above, redundant descriptions will be omitted, and the following description will focus on the differences.

[0093] The second body 210 is a portion where other components of the second pressing unit 200 are installed, and is connected to the driving unit (not illustrated) to operate up and down along the second lifting direction D2. The second body 210 may have the same or similar shape as the first body 110. For example, the second body 210 may have a cylindrical shape that extends along the first direction A1 described above.

[0094] The second connecting portion 220 may be coupled to the second body 210 so as to extend along a third direction A3 different from the first direction A1. For example, the third direction A3 may be a direction perpendicular to the first direction A1. In this case, the third direction A3 may be the same or parallel to the second direction A2. Although the present disclosure is not limited thereto, the following description will focus on the case where the third direction A3 is the same or parallel to the second direction A2.

[0095] The second pressing portion 230 may be a portion that directly presses the lower surface of the plated steel sheet 10 during the press-forming. The second pressing portion 230 may be disposed on the second connecting portion 220. In this case, the second pressing portion 230 may be in a form that protrudes outwardly from an outer surface of the second connecting portion 220. An end portion of the second pressing portion 230 that protrudes outwardly as described above shall be referred to as the second outer end portion.

[0096] Since the second connecting portion 220 is formed to extend in the same direction as the first con-

necting portion 120, the second pressing portion 230 may be arranged symmetrically with respect to the first pressing portion 130 along the second direction A2 or the third direction A3. Additionally, when the plurality of second pressing portions 230 are provided, the second pressing portions 230 may be disposed to face one-to-one with the plurality of first pressing portions 130 disposed on the upper side.

[0097] Referring back to FIGS. 6 and 7, the apparatus 20 for manufacturing a plated steel sheet according to Embodiment 1 may be configured such that the first pressing unit 100 and the second pressing unit 200 are rotatably configured.

[0098] More specifically, the first pressing unit 100 may rotate the first body 110 around a first rotation axis C1. In this case, the first rotation axis C1 may pass through the center of the first body 110 and extend parallel to the first direction A1. As the first body 110 rotates, the first connecting portion 120 and the first pressing portion 130 may also rotate together. Additionally, the second pressing unit 200 may rotate the second body 210 around a second rotation axis C2. In this case, the second rotation axis C2 may pass through the center of the second body 210 and extend parallel to the first direction A1. As the second body 210 rotates, the second connecting portion 220 and the second pressing portion 230 may also rotate together. In this case, the first pressing portion 130 and the second pressing portion 230 may be configured in the form of a pressurizing roll.

[0099] In this case, the plated steel sheet 10 may be supplied between the rotating first pressing unit 100 and the second pressing unit 200. In this case, one end of the plated steel sheet 10, which is wound in a coil form, may be unwound and supplied between the pressing units 100 and 200. The press-forming may be performed by pressing the upper and lower ends of the supplied plated steel sheet 10 with the rotating first pressing portion 130 and the second pressing portion 230.

[0100] In this way, during the press-forming, one surface (i.e., upper surface) of the plated steel sheet 10 is pressed downwardly by the first pressing portion 130, and the other surface (i.e., lower surface) of the plated steel sheet 10 may be pressed upwardly by the second pressing portion 230. By doing so, a pair of pressed portions 13 may be formed in the plated steel sheet 10. In this case, since the first pressing portion 130 and the second pressing portion 230 are symmetrically disposed, the pair of pressed portions 13 may also be formed at symmetrical positions so that their centers C are aligned on the same line.

[0101] Referring to FIGS. 6 and 8, the apparatus 20A for manufacturing a plated steel sheet according to another embodiment (hereinafter, Embodiment 2) of the present disclosure may include the first pressing unit 100 and the second pressing unit 200. In this case, since most of the features of the pressing units 100

and 200 are identical or similar to those of the above-described Embodiment 1, the following description will focus on the differences.

[0102] The first pressing unit 100 and the second pressing unit 200 are disposed to face each other, which is the same as the above-described Embodiment 1. With the pressing units 100 and 200 disposed in this manner, the pressing units 100 and 200 may move up and down toward each other or away from each other. Before the first pressing unit 100 and the second pressing unit 200 begin to move up or down toward each other, there is a gap between the pressing units 100 and 200, and the plated steel sheet 10 may be supplied into this gap. In this case, the supplied plated steel sheet 10 may be in the form of a flat plate. When the plated steel sheet 10 is supplied, the first pressing unit 100 may be lowered toward the upper surface of the plated steel sheet 10, and the second pressing unit 200 may be raised toward the lower surface of the plated steel sheet 10.

[0103] When the first body 110 is lowered in this manner, the first connecting portion 120 and the first pressing portion 130 may also be lowered together. Accordingly, the outer surface 131a of the first outer end portion 130a of the first pressing portion 130 may come into contact with the upper plating layer 12a of the plated steel sheet 10. As the second body 210 is raised, the second connecting portion 220 and the second pressing portion 230 is also raised together, so the outer surface of the second outer end portion of the second pressing portion 230 may come into contact with the lower plating layer 12b of the plated steel sheet 10.

[0104] Thereafter, as illustrated in FIG. 8, the first body 110 may be lowered further and the second body 210 may be raised further. Accordingly, the first pressing portion 130 may press the plated steel sheet 10 downwardly while the outer surface 131a of the first outer end portion 130a comes into contact with the upper plating layer 12a. The second pressing portion 230 may press the plated steel sheet 10 upwardly while the outer surface of the second outer end portion is in contact with the lower plating layer 12b.

[0105] In this way, as the plated steel sheet 10 is pressed in the up and down direction, the upper plating layer 12a is pressed to form the pressed portion (upper pressed portion) 23 in the shape of the groove that is concave inwardly, and the lower plating layer 12b is pressed to form the pressed portion (lower pressed portion) 13 in the shape of the groove that is concave inwardly.

[0106] As described above, during the press-forming, the upper surface of the plated steel sheet 10 is pressed downwardly by the first pressing portion 130, and the lower surface of the plated steel sheet 10 is pressed upwardly by the second pressing portion 230, thereby forming the pair of pressed portions 13. In this case, since the first pressing portion 130 and the sec-

ond pressing portion 230 are symmetrically disposed, the pair of pressed portions 13 may also be formed at symmetrical positions so that their centers C are aligned on the same line.

[0107] FIG. 10a is a diagram illustrating a pressing portion of another pressing unit of the present disclosure. FIG. 10b is a diagram illustrating a pressing portion of another pressing unit of the present disclosure.

[0108] Referring to FIG. 10a, the first outer end portion 130b of the first pressing portion 130 according to another embodiment of the present disclosure may have an elliptical cross-section when viewed from the side. In this case, the width and protrusion distance of the first outer end portion 130b may differ from that of the first outer end portion 130a having a circular cross-section. For example, the first outer end portion 130b having an elliptical cross-section may have a greater width than the first outer end portion 130a having a circular cross-section. Additionally, the first outer end portion 130b may be formed to have a shorter or equal protrusion distance than the first outer end portion 130a.

[0109] Referring to FIG. 10b, the first outer end portion 130c of the first pressing portion 130 according to another embodiment of the present disclosure may have a rectangular cross-section with rounded corners when viewed from the side. The width and protrusion distance of this first outer end portion 130b may differ from the first outer end portions 130a and 130b described above. For example, the first outer end portion 130c having a cross-section similar to a rectangle may be formed to have a smaller width than the first outer end portions 130a and 130b described above, but is not limited thereto.

[0110] Meanwhile, although only the first pressing portion 130 is illustrated in FIGS. 10a and 10b, the second pressing portion 230 may also have the same shape as the first pressing portion 130 facing it, and it goes without saying that a single apparatus for manufacturing a plated steel sheet apparatus 20 for manufacturing a plated steel sheet may include a combination of different shapes of pressing portions as described above.

[0111] In this way, by forming the pressing portion 130 and 230 in a shape that is entirely or at least has curved edges, it is possible to prevent pressure from being concentrated on a part of the plating layer 12a and 12b. By doing so, even when the pressing portion has a sharp shape, it is possible to prevent the plating layers 12a and 12b from being torn or detached during the press-forming process, thereby effectively suppressing the occurrence of rust on the plated steel sheet 10 after cutting.

[0112] Meanwhile, when the first and second pressing portions 230 press the plated steel sheet 10, a pressure within a predetermined range may be applied. The pressure applied during the pressing operation may be, for example, within a range of 5 to 300 kg/cm²,

and preferably within 5 to 50 kg/cm². This pressure may be adjusted based on at least one of the physical properties of the plated steel sheet 10, such as thickness and strength, or the number of pressing portions 130 and 230. For example, when the number of pressing portions 130 and 230 provided in the apparatus 10, or the thickness or strength of the plated steel sheet 10 increases, the applied pressure may also increase.

[0113] Meanwhile, the apparatus 20 for manufacturing a plated steel sheet may further include a control unit (not illustrated). The control unit may control the operation of the apparatus for manufacturing a plated steel sheet apparatus 20 for manufacturing a plated steel sheet. In this case, the control unit may be implemented in the form of, for example, a circuit board mounted on a control computer for the apparatus 20 for manufacturing a plated steel sheet, a computer chip mounted on the circuit board, or software embedded in the computer chip or embedded in the control computer.

[0114] The method for controlling, by the control unit, the apparatus 20 for manufacturing a plated steel sheet may be as follows. First, the plated steel sheet 10, which is the object to be pressed, may be supplied between the pressing units 100 and 200. In this case, the first pressing unit 100 and the second pressing unit 200 may be spaced apart by a predetermined distance such that the plated steel sheet 10 may be transported therebetween. In addition, the supply of the plated steel sheet 10 may be performed by a separate transfer device (not illustrated), such as a conveyor.

[0115] Next, the control unit may determine (calculate) the press pressure based on the physical properties (e.g., thickness, strength, etc.) of the supplied plated steel sheet 10. In this case, the physical properties of the plated steel sheet 10 may be obtained by being a value entered into the control unit in advance by the operator, or by being measured by a sensor (not illustrated) equipped in the apparatus 10.

[0116] Next, the control unit may raise and lower the pressing units 100 and 200 so that they move toward each other. More specifically, by the control unit, the first pressing unit 100 may be lowered toward the plated steel sheet 10, and the second pressing unit 200 may be raised toward the plated steel sheet 10. In this case, in the case of Embodiment 1, the control unit may rotate the pressing units 100 and 200.

[0117] While rotating in this way, the first pressing portion 130 may come into contact with the upper plating layer 12a, and the second pressing portion 230 may come into contact with the lower plating layer 12b. Subsequently, as the pressing portions 130 and 230 continue to rotate, the plating layer 12a and 12b may be pressed. Accordingly, a pair of pressed portions 13 may be formed on the upper and lower surfaces of the plated steel sheet 10 at symmetrical positions along the vertical direction.

[0118] Meanwhile, in the case of Embodiment 2, the

control unit may lower the first pressing unit 100 and raise the second pressing unit 200 after the first pressing portion 130 comes into contact with the upper plating layer 12a and the second pressing portion 230 comes into contact with the lower plating layer 12b. By doing so, the plated steel sheet 10 may be pressed in the vertical direction with the pressure determined (calculated) as described above, thereby forming a pair of pressed portions 13.

[0119] Next, when the pressed portions 13 are formed to a predetermined depth P1, the control unit may raise the pressing units 100 and 200 so that they move away from each other. Subsequently, the press-formed plated steel sheet 10 may be transferred to a cutting device via a transfer device. The control unit may control the cutting device to cut the plated steel sheet 10 along a virtual centerline C of the pair of pressed portions 13.

[0120] However, the present disclosure is not limited thereto, and the apparatus 20 for manufacturing a plated steel sheet may not be equipped with the control unit. In this case, the apparatus 20 for manufacturing a plated steel sheet press-forms the plated steel sheet 10 by the operation of a worker, and the worker may then cut the plated steel sheet 10 using the cutting device.

[0121] Referring back to FIG. 2, the plated steel sheet 10 press-formed by the apparatuses 20 and 20A for manufacturing a plated steel sheet according to Embodiment 1 or Embodiment 2 of the present disclosure may have the pressed portions 13 formed on the upper end portion and the lower end portion of the plated steel sheets 10 and 10A, respectively. In this case, as described above, the upper and lower pressed portions 13 may have the same or similar shape and size to each other.

[0122] The width L1 of the pressed portion 13 may be a size corresponding to the width L2 of the pressing portion 130 and 230. Accordingly, the pressed portion 13 may be formed with a smaller width than the connecting portions 120 and 220. For example, when the pressing portion 130 and 230 has a width L2 of 0.5 mm to 8 mm, the pressed portion 13 formed using the pressing portion 130 and 230 may also have a width L1 within the range of 0.5 mm to 8 mm.

[0123] A protrusion distance P2 of the pressing portion 130 and 230 may be greater than the thickness T2 of the plating layer 12a and 12b and smaller than the total thickness T1 of the plated steel sheets 10 and 10A. As the pair of pressed portions 13 are formed by these pressing portions 130 and 230, the thickness T3 of the pressed plated steel sheets 10 and 10A may be processed to be, for example, 10 to 90% of the thickness T1 before the pressing.

[0124] FIG. 12 is a diagram schematically illustrating a stage in which the apparatus for manufacturing a plated steel sheet according to another embodiment of the present disclosure has not yet press-formed the plated steel sheet. FIG. 13 is a diagram schematically

illustrating a stage in which a steel sheet processing apparatus of FIG. 11 press-forms the plated steel sheet.

[0125] Referring to FIGS. 12 and 13, an apparatus 20B for manufacturing a plated steel sheet according to another embodiment (hereinafter, Embodiment 3) of the present disclosure may include one pressing unit 100 and a support portion 300 to the increase in the applied pressure.

[0126] The support portion 300 may be disposed on a floor, an inner wall, etc., of a building where the plated steel sheet processing device 20B is installed. The support portion 300 may be fixedly installed at the above location. The support portion 300 may be in the form of a flat plane such that its upper surface is parallel to the longitudinal direction of the plated steel sheet 10B or the longitudinal direction of the body 110. The plated steel sheet 10B may be supported on an upper surface of such a support portion 300.

[0127] The pressing unit 100 may be disposed to face the support portion 300 with the plated steel sheet 10B interposed therebetween. In this case, the pressing unit 100 may move up and down toward or away from the upper surface of the plated steel sheet 10B. For example, during the press-forming, the pressing unit 100 may be lowered to press the upper plating layer 12a of the plated steel sheet 10B supported on the support portion 300. As another example, the body 100 may be rotatably provided so that the plated steel sheet 10B supported on the support portion 300 may be press-formed by the pressing portion 130 that rotates together with the body 100.

[0128] By the press-forming in this manner, the pressed portion 13 may be formed only on the upper end portion of the plated steel sheet 10B. Since the specific features of the other pressing unit 100 and the pressing portion 130 provided therein are identical or similar to those described above, a redundant description will be omitted.

[0129] Referring back to FIG. 5b, the plated steel sheet 10B press-formed by the apparatus 20B for manufacturing a plated steel sheet according to Embodiment 3 of the present disclosure may have the pressed portion 13 formed only on the upper end portion of the plated steel sheet 10B. In this case, the width L1 of the pressed portion 13 may be a size corresponding to the width L2 of the pressing portion 130 and 230. The protrusion distance P2 of the pressing portion 110 is greater than the thickness T2 of the plating layer 12a and 12b and smaller than the total thickness T1 of the plated steel sheet 10B, which is the same as the plated steel sheet 10 according to Embodiment 1.

[0130] Meanwhile, the width L1 and depth P1 of the pressed portion 13 may vary based on the pressure applied to the plated steel sheet 10B. More specifically, as the applied pressure increases, both the width L2 and the depth P2 of the pressed portion 13 formed on the plated steel sheet 10B may increase in proportion

to the applied pressure. On the other hand, as the applied pressure increases, the distance between a pair of pressed portions 13 facing each other, that is, the thickness T3 of the press-formed plated steel sheet 10B, may decrease in inverse proportion to the applied pressure.

[0131] The apparatuses 20, 20A, and 20B for manufacturing a plated steel sheet may include the cutting device (not illustrated). The cutting device may adjust the length by cutting a cutting target portion CP of the plated steel sheets 10, 10A, and 10B. For example, the cutting device may perform a cutting process by using a cutting cutter (not illustrated) to cut the cutting target portion CP along the cutting direction. The cutting direction may be a direction parallel to the second direction B2 or the vertical direction Z, as described above. Through such a cutting process, the plated steel sheets 10, 10A, and 10B may be divided into at least two or more.

[0132] In the above case, when the press-forming of the plated steel sheets 10, 10A, and 10B is completed by the apparatuses 20, 20A and 20B for manufacturing a plated steel sheet, the pressed portion 13 may be cut in the vertical direction by the cutting device (not illustrated). In this case, in order to minimize the area of the steel sheet 11 exposed externally, the position [e.g., the central portion C of the pressed portion 13] where the thickness of the pressed portion 13 is minimal may be cut. The cut plated steel sheets 10, 10A, and 10B may be used in various manufacturing processes.

[0133] Referring back to FIGS. 6 through 11, the method of manufacturing the plated steel sheets 10, 10A, and 10B according to embodiments of the present disclosure using the apparatus 20 for manufacturing a plated steel sheet, 20A, and 20B may be as follows. Hereinafter, for convenience of description, the following description will focus on the apparatus 20 for manufacturing a plated steel sheet and the plated steel sheet 10 according to Embodiment 1.

[0134] First, the plated steel sheet 10 may be supplied to the apparatus 20 for manufacturing a plated steel sheet. In this case, the supplied plated steel sheet 10 may have an upper surface and a lower surface that are flat, and may have a uniform or substantially uniform thickness T1 overall. That is, the plated steel sheet 10 before the start of processing may be in a shape that includes only the first plated steel sheet region A10. The plated steel sheet 10 may be in a wound state before being supplied to the manufacturing apparatus 20. When the manufacturing process starts, one end portion of the wound plated steel sheet 10 may be unwound and supplied between the pressing units 100 and 200.

[0135] Next, the press-forming may be performed to form the pressed portion 13 on the plated steel sheet 10. In this case, the pressing portions 130 and 230 that are rotated by the bodies 110 and 210 may press the upper surface and lower surface of the plated steel

sheet 10. The timing of supplying the plated steel sheet 10 may be after the pressing units 100 and 200 start rotating, or simultaneously with the start of rotation.

[0136] More specifically, by passing the plated steel sheet 10 between the rotating pressing portions 130 and 230, the first pressed portion 13a may be formed on the upper end portion of the plated steel sheet 10, and the second pressed portion 13b may be formed on the lower end portion of the plated steel sheet 10. In this case, the first pressed portion 13a and the second pressed portion 13b may be formed at positions facing each other along the second direction B2. By the press-forming, the first plated steel sheet region A10 and the second plated steel sheet region A20 may be formed in the plated steel sheet 10 so as to be continuous with each other along the width direction (first direction) B1. In this case, the cut portion 14 may not be formed in the second plated steel sheet region A20.

[0137] Meanwhile, during the pressing process step, the press pressure applied by the pressing units 100 and 200 to the plated steel sheet 10 may be adjusted to match the shape of the plated steel sheet 10 to be manufactured. The press pressure may be adjusted, for example, within a range of 5 kg/cm² to 300 kg/cm², but is not limited thereto. Based on such press pressure, the width L1 and pressing depth P1 of the pressed portion 13 may be changed. For example, when the pressure applied to the plated steel sheet 10 increases or decreases, the width L1 of the pressed portion 13 [or the width of the second plated steel sheet region] and the pressing depth P1 may increase or decrease in proportion to the change in pressure.

[0138] In addition, since the thickness T3 of the cut portion 14 formed through the cutting process step described later is determined by the thickness of the second plated steel sheet region A20, the thickness T3 of the cut portion 14 may also be changed based on the press pressure. For example, when the applied press pressure increases or decreases, the thickness T3 of the cut portion 14 may decrease or increase in inverse proportion to the applied press pressure. Accordingly, the area of the second steel sheet region A21 exposed externally through the cut portion 14 may be determined.

[0139] Next, after the press-forming is completed, the cutting process may be performed to form the cut portion 14 in the plated steel sheet 10. In the cutting process step, the first pressed portion 13a and the second pressed portion 13b, which are disposed to face each other, may be cut simultaneously using a cutting cutter (not illustrated). In this case, the cutting cutter may cut the second plated steel sheet region A20 along a direction parallel to the thickness direction (second direction) B2 of the plated steel sheet 10 while passing through the common center C of the pressed portions 13a and 13b. By doing so, the cut portion 14 may be formed at the second end portion E2 of the second plated steel sheet region A20.

[0140] Meanwhile, in the cutting process step, as the second plated region A20 is cut by the cutting cutter, a portion of the plating material contained in the second plated region A20 may move onto the cut portion 14 to form the third plated region A30. The third plated region A30 may cover at least partially the cut portion 14 by having a shape that extends along the second direction B2.

[0141] Alternatively, at the time of the initial cutting, there is no plating material on the cut portion 14, but a portion of the plating material from the second plated region A20 may move onto the cut portion 14 due to sacrificial corrosion protection, thereby forming the third plated region A30.

[0142] Thereafter, the plated steel sheet 10 after the cutting process is completed may be transported for subsequent processes or manufacturing operations depending on its intended use.

[0143] In the plated steel sheets 10, 10A, and 10B according to the embodiments of the present disclosure as described above, the area of the steel sheet 11 exposed externally by the cutting process may be minimized by reducing the thickness of the cutting target location through the press-forming and then cutting the press-formed portion. By doing so, the time for rust to occur in the cut portion is delayed, thereby allowing the plated steel sheets 10, 10A, and 10B to retain improved corrosion resistance even after the cutting.

[0144] In addition, since the pressed portion 13 may be formed in the plated steel sheets 10, 10A, and 10B in the inwardly curved shape during the press-forming, it is possible to prevent damage, such as damage or peeling of the plating layer 12, from occurring during the press-forming process compared to a case where the conventional sharp-shaped structure is used. Furthermore, by applying pressure using the curved pressing portions 130 and 230 corresponding to the pressed portion 13 during the press-forming, it is possible to prevent a portion in which the thickness and plating amount are sharply reduced from being formed at the pressed portion 13, thereby further improving the corrosion resistance of the plated steel sheets 10, 10A, and 10B.

[0145] FIG. 14a is a diagram illustrating a state of the plated steel sheet before a cutting process. FIG. 14b is a diagram illustrating the plated steel sheet with a cut portion formed by the cutting process. FIG. 15 is a diagram schematically illustrating a state of the plated steel sheet according to the present disclosure after completion of the cutting process and before the press-forming. FIG. 16 is a cross-sectional view of an enlarged portion of a plated steel sheet manufactured after the completion of the cutting process and press-forming.

[0146] Referring to FIGS. 14a through 16, a method for manufacturing plated steel sheets 10, 10A, and 10B according to another embodiment of the present disclosure (hereinafter referred to as the method for manu-

facturing a plated steel sheet) may be as follows. Such a method for manufacturing a plated steel sheet may be performed using the apparatuses 20, 20A, and 20B for manufacturing a plated steel sheet. Hereinafter, for convenience of description, the following description will focus on the apparatus 20 for manufacturing a plated steel sheet and the plated steel sheet 10 according to Embodiment 1.

[0147] First, the plated steel sheet 10 may be supplied to the apparatus 20 for manufacturing a plated steel sheet. In this case, since the specific method of supplying the plated steel sheet 10 is identical or similar to those described above, redundant description will be omitted.

[0148] Next, the cutting process step for forming the cut portion 14 on the plated steel sheet 10 may be performed by the cutting device. In the cutting process step, a portion (i.e., the cutting target portion) CP of the plated steel sheet 10 may be cut using the cutting cutter (not illustrated). In this case, the cutting cutter may cut the cutting target portion CP along a direction parallel to the thickness direction (second direction) B2 of the plated steel sheet 10.

[0149] By doing so, the cut portion 14 is formed, thereby allowing the plurality of plated steel sheets 10 with an adjusted (reduced) length to be manufactured. In the cutting process step, at least one cutting target portion CP of the plated steel sheet 10 is cut by the cutting device, thereby forming at least two cut portions 14. For example, two or three or more cut portions 14 may be formed.

[0150] Meanwhile, in the cutting process step, as the plated steel sheet 10 is cut by the cutting cutter, a portion of the plating material contained in the second plated region A20 may move onto the cut portion 14. By doing so, the third plated region A30 may be formed on the plated steel sheet 10. The third plated region A30 may cover at least partially the cut portion 14 by having a shape that extends along the second direction B2.

[0151] Alternatively, at the time of the initial cutting, there is no plating material on the cut portion 14, but a portion of the plating material from the second plated region A20 may move onto the cut portion 14 due to sacrificial protection, thereby forming the third plated region A30.

[0152] Next, the press-forming step may be performed to form the pressed portion 13 on the plated steel sheet 10. After the cutting process step, the plated steel sheet 10 in which the cut portion 14 is formed may pass between the rotating pressing portions 130 and 230. In this process, the pressing portions 130 and 230 that are rotated by the bodies 110 and 210 may press the upper surface and lower surface of the plated steel sheet 10. The pressing portions 130 and 230 may press a pressing target portion PP of the plated steel sheet 10.

[0153] The pressing target portion PP is a part of the upper surface and lower surface of the plated steel

sheet 10 and may be a region including the cut portion 140. More specifically, two pressing target portions PP may be a set, with one existing on the upper surface and one on the lower surface of the plated steel sheet 10. Two pressing target portions PP may be positioned facing each other along the thickness direction (second direction) B2 of the plated steel sheet 10. In this case, the cut portion 14 may be positioned at the common center C of the two pressing target portions PP.

[0154] By the press-forming the two pressing target portions PP by the pressing portions 130 and 230, the pressed portion 13 may be formed on the plated steel sheet 10. More specifically, an upper pressed portion 13A may be formed on the upper end portion of the plated steel sheet 10, and a lower pressed portion 13B may be formed on the lower end portion of the plated steel sheet 10. The upper pressed portion 13A and the lower pressed portion 13B may be formed facing each other along the second direction B2 as they are formed on the pressing target portions PP. In this case, the upper pressed portion 13A and the lower pressed portion 13B facing each other may be cut by the cut portion 14 passing through the center C. That is, the upper pressed portion 13A may include the two first pressed portions 13a that are cut from each other, and the lower pressed portion 13B may include the two second pressed portions 13b that are cut from each other.

[0155] Additionally, the pressing target portion PP may be provided in a plurality of sets corresponding to the number of cut portions 14. The set of the plurality of pressing target portions PP may be positioned at predetermined intervals along the longitudinal direction B1 of the plated steel sheet 10. Here, the predetermined interval may correspond to the interval at which the plurality of cut portions 14 are spaced apart from each other. In this case, the set of the plurality of pressing target portions PP may be pressed simultaneously by the rotating pressing portions 130 and 230. Accordingly, the plurality of upper pressed portions 13A are formed on the upper surface of the plated steel sheet 10, and the plurality of lower pressed portions 13B may be formed on the lower surface of the plated steel sheet 10 so as to face the upper pressed portions 13A one-to-one. As described above, the plurality of upper pressed portions 13A and the plurality of lower pressed portions 13B are each cut by the cut portions 14.

[0156] By the press-forming step, the first plated steel sheet region A10 and the second plated steel sheet region A20 may be formed in the plated steel sheet 10 so as to be continuous with each other along the width direction (first direction) B1. Meanwhile, in the press-forming step, the plated steel sheet 10 in which the cut portion 140 is formed may be supplied between the pressing units 100 and 200 after the pressing units 100 and 200 start to rotate, or may be supplied simultaneously with the start of rotation of the pressing units 100 and 200.

[0157] In addition, during the pressing process step,

the press pressure applied by the pressing units 100 and 200 to the plated steel sheet 10 may be adjusted to match the shape of the plated steel sheet 10 to be manufactured. The press pressure may be adjusted, for example, within a range of 5 kg/cm² to 300 kg/cm², but is not limited thereto. Based on such press pressure, the width L1 and pressing depth P1 of the pressed portion 13 may be changed. For example, when the pressure applied to the plated steel sheet 10 increases or decreases, the width L1 of the pressed portion 13 [or the width of the second plated steel sheet region] and the pressing depth P1 may increase or decrease in proportion to the change in pressure.

[0158] In addition, since the thickness T3 of the cut portion 14 is determined by the thickness of the second plated steel sheet region A20, the thickness T3 of the cut portion 14 may also be changed based on the press pressure. For example, when the applied press pressure increases or decreases, the thickness T3 of the cut portion 14 may decrease or increase in inverse proportion to the applied press pressure. Accordingly, the area of the second steel sheet region A21 exposed externally through the cut portion 14 may be determined.

[0159] By sequentially performing the cutting process step and the press-forming step described above, the plated steel sheet 10 including the first plated steel sheet region A10 and the second plated steel sheet region A20 including the pressed portion 13 and the cut portion 14 may be manufactured. The plated steel sheet 10 manufactured in this way may be transported for subsequent processes or manufacturing operations depending on its intended use. The plated steel sheets 10, 10A, and 10B according to the embodiments of the present disclosure as described above are manufactured by reducing the thickness by performing press-forming on a pressing target portion PP including a cutting target portion CP after a cutting process is performed on the cutting target portion CP, which is a cutting target location, thereby minimizing the area of the steel sheet 11 exposed externally by the cutting process. By doing so, the time for rust to occur in the cut portion is delayed, thereby allowing the plated steel sheets 10, 10A, and 10B to retain improved corrosion resistance even after the cutting.

[0160] In addition, since the pressed portion 13 may be formed in the plated steel sheets 10, 10A, and 10B in the inwardly curved shape during the press-forming, it is possible to prevent damage, such as damage or peeling of the plating layer 12, from occurring during the press-forming process compared to a case where the conventional sharp-shaped structure is used. Furthermore, by applying pressure using the curved pressing portions 130 and 230 corresponding to the pressed portion 13 during the press-forming, it is possible to prevent a portion in which the thickness and plating amount are sharply reduced from being formed at the pressed portion 13, thereby further improving the

corrosion resistance of the plated steel sheets 10, 10A, and 10B.

[0161] The plated steel sheets 10, 10A, and 10B according to the embodiments of the present disclosure as described above may minimize the area of the steel sheet 11 exposed externally even after the cutting process by reducing the thickness by performing press-forming on a cutting target location before or after the cutting process. By doing so, the time for rust to occur in the cut portion is delayed, thereby allowing the plated steel sheets 10, 10A, and 10B to retain improved corrosion resistance even after the cutting.

[0162] In addition, since the pressed portion 13 may be formed in the plated steel sheets 10, 10A, and 10B in the inwardly curved shape during the press-forming, it is possible to prevent damage, such as damage or peeling of the plating layer 12, from occurring during the press-forming process compared to a case where the conventional sharp-shaped structure is used. Furthermore, by applying pressure using the curved pressing portions 130 and 230 corresponding to the pressed portion 13 during the press-forming, it is possible to prevent a portion in which the thickness and plating amount are sharply reduced from being formed at the pressed portion 13, thereby further improving the corrosion resistance of the plated steel sheets 10, 10A, and 10B.

[0163] While example embodiments have been shown and described above, it will be apparent to those skilled in the art that modifications and variations could be made without departing from the scope of the present disclosure as defined by the appended claims.

Industrial Applicability

[0164] The present disclosure is applicable to an industrially applicable plated steel sheet, and to an apparatus and a method for manufacturing the same.

Claims

1. A plated steel sheet, comprising:

a first plated steel sheet region extending in a first direction and including a first steel sheet region and a first plated region; and
a second plated steel sheet region extending in the first direction and including a second steel sheet region and a second plated region, wherein the second plated steel sheet region includes:

a first end portion continuous with the first plated steel sheet region;
a second end portion formed in a direction opposite to the first end portion;
a pressed portion pressed inwardly from

- an upper surface or a lower surface of the second plated region by a pressing depth in the second direction; and
a cut portion disposed in the second end portion of the second plated steel sheet region and extending in the second direction, and
wherein a width of the second plated steel sheet region is greater than the pressing depth.
2. The plated steel sheet of claim 1, wherein the pressed portion has the pressing depth that changes along the first direction.
 3. The plated steel sheet of claim 2, wherein the pressing depth of the pressed portion increases from the first end portion of the second plated steel sheet region toward the second end portion along the first direction.
 4. The plated steel sheet of claim 1, wherein the pressed portion has a curved shape toward an inner side of the second plated steel sheet region.
 5. The plated steel sheet of claim 4, wherein a slope of a tangent line of the pressed portion changes along the first direction between the first end portion and the second end portion of the second plated steel sheet region.
 6. The plated steel sheet of claim 5, wherein an average slope of the tangent line between a center of the first end portion and the second end portion of the second plated steel sheet region and the second end portion is 45° or less.
 7. The plated steel sheet of claim 4, wherein the pressed portion has a minimum radius of curvature at the second end portion of the second plated steel sheet region and a maximum radius of curvature at the first end portion of the second plated steel sheet region.
 8. The plated steel sheet of claim 7, wherein the minimum radius of curvature is 0.25 mm.
 9. The plated steel sheet of claim 1, wherein a thickness of the second plated steel sheet region is 10% to 90% of that of the first plated steel sheet region.
 10. The plated steel sheet of claim 1, wherein the second plated region has a first thickness at the first end portion of the second plated steel sheet region, and has a second thickness less than or equal to the first thickness at the second end portion of the second plated steel sheet region.
 11. The plated steel sheet of claim 1, further comprising:
a third plated region extending in the second direction and at least partially covering the cut portion.
 12. The plated steel sheet of claim 11, wherein the third plated region has a smaller thickness than the second plated region.
 13. The plated steel sheet of claim 11, wherein the third plated region has a smaller plating amount than the second plated region.
 14. The plated steel sheet of claim 1, wherein the second plated region has greater density than the first plated region.
 15. The plated steel sheet of claim 1, wherein the second steel sheet region has greater density than the first steel sheet region.
 16. The plated steel sheet of claim 1, wherein a width of the pressed portion is 0.25 mm to 4 mm.
 17. The plated steel sheet of claim 1, wherein the second plated steel sheet region includes a first pressed portion that is concave downward from the upper surface of the second plated region, and a second pressed portion that is disposed to face the first pressed portion and is concave upward from the lower surface of the second plated region.
 18. A method for manufacturing a plated steel sheet, comprising:

supplying a plated steel sheet including a first plated steel sheet region that includes a first plated region and a first steel sheet region;
forming a second plated steel sheet region, extending in a first direction and includes a second plated region and a second steel sheet region, by press-forming the plated steel sheet; and
forming a cut portion extending in a second direction in the second plated steel sheet region.
 19. The method of claim 18, wherein, in the forming of the second plated steel sheet region, a pressed portion is formed to be concave toward an inner side of the second plated region along the second direction and has a width greater than a pressing depth.
 20. The method of claim 19, wherein press pressure applied to the second plated region is 5 kg/cm² to 300 kg/cm².

21. The method of claim 20, wherein, in the forming of the cut portion, the cut portion is formed to pass through a center of the pressed portion.

22. The method of claim 20, wherein, in the forming of the cut portion, a third plated region is further formed that extends along the second direction and at least partially covers the cut portion.

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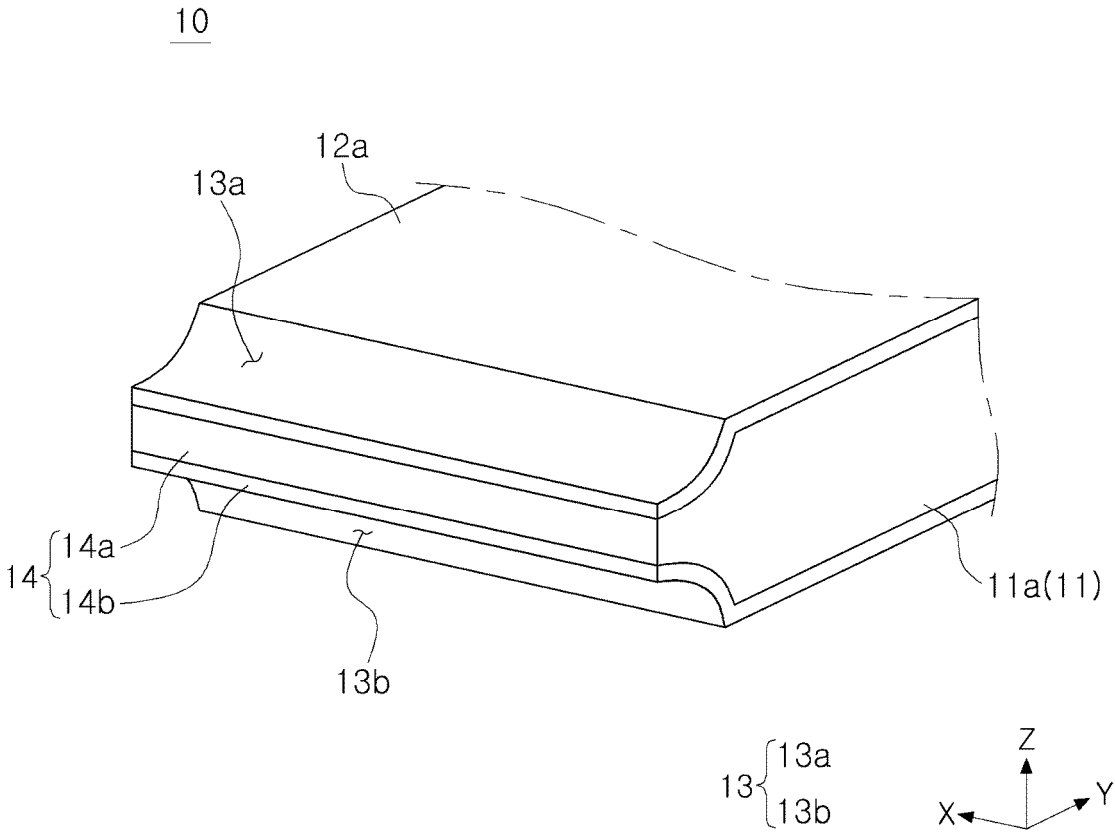
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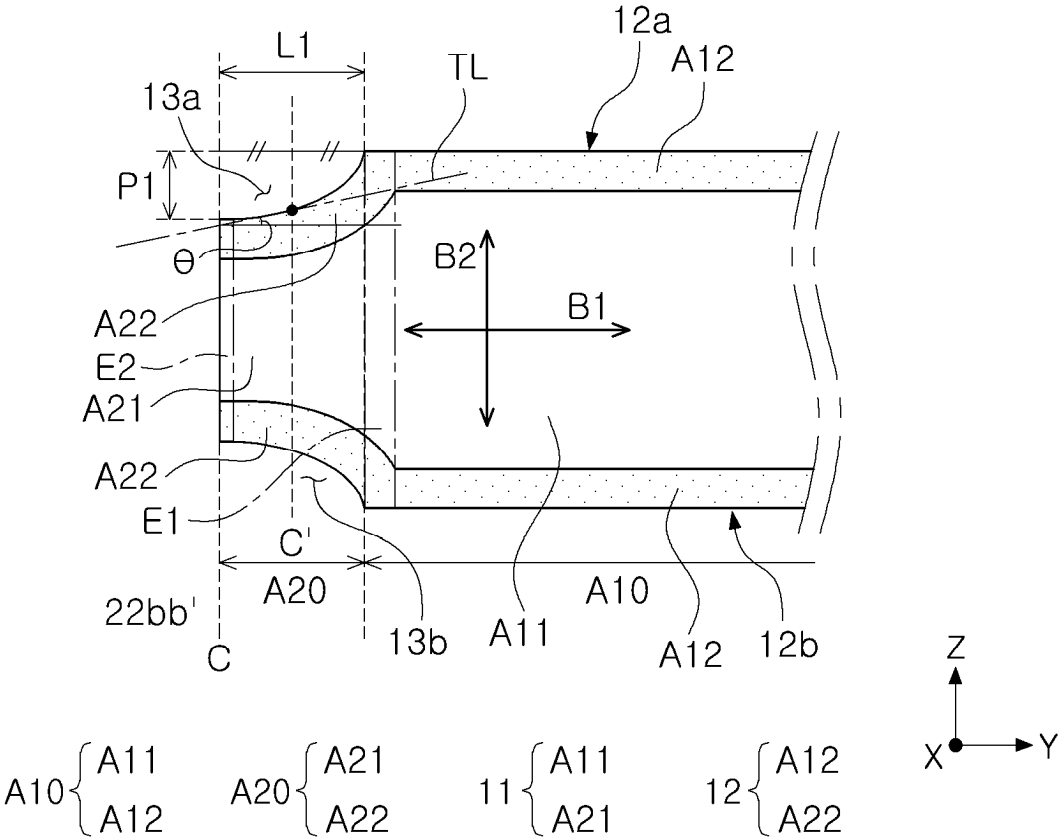
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[FIG. 1]

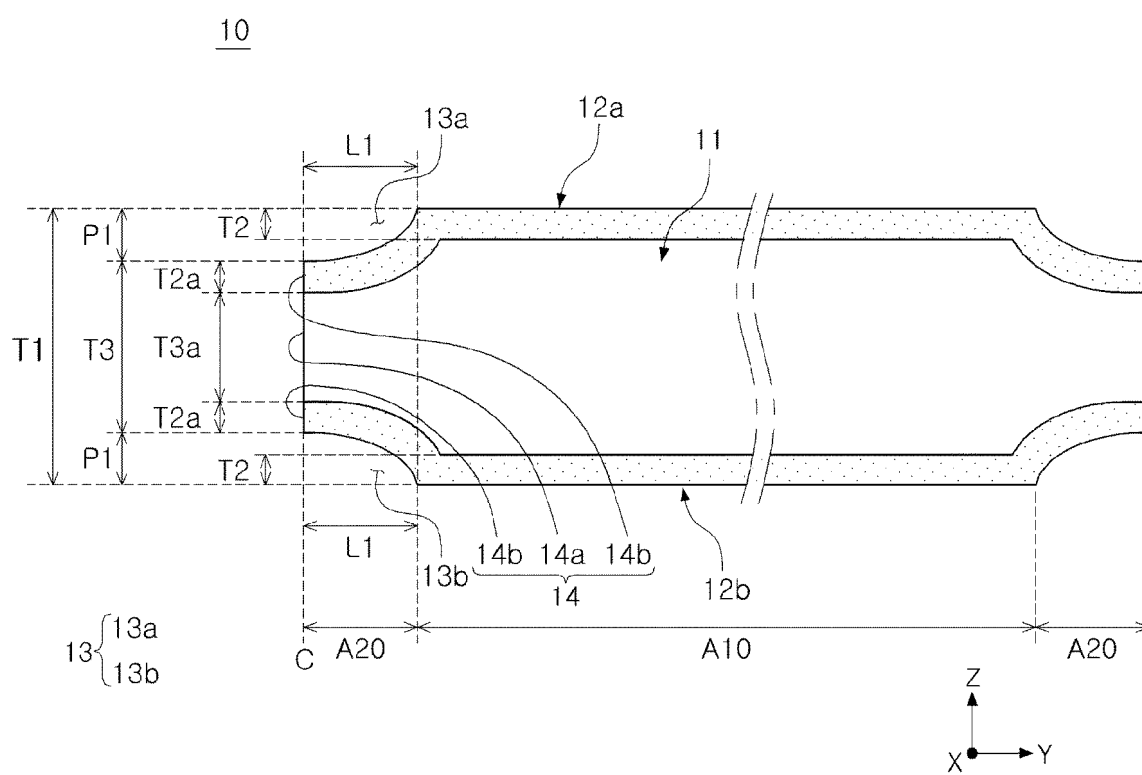


[FIG. 2]

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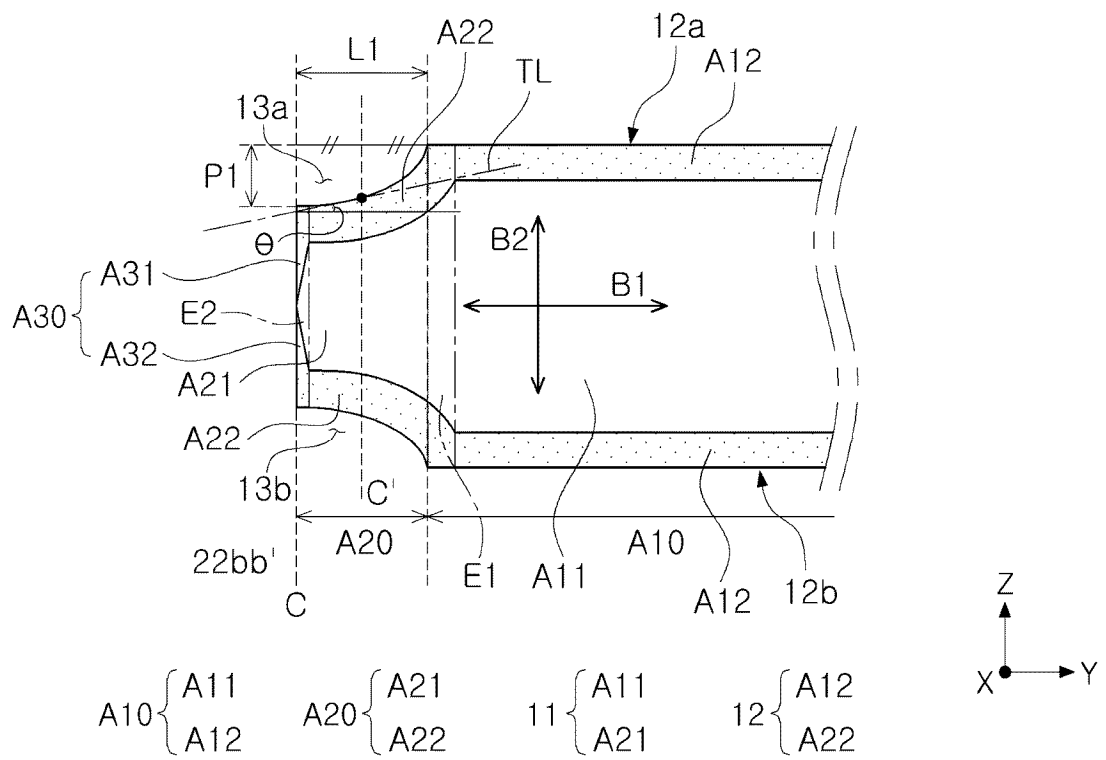


[FIG. 3]

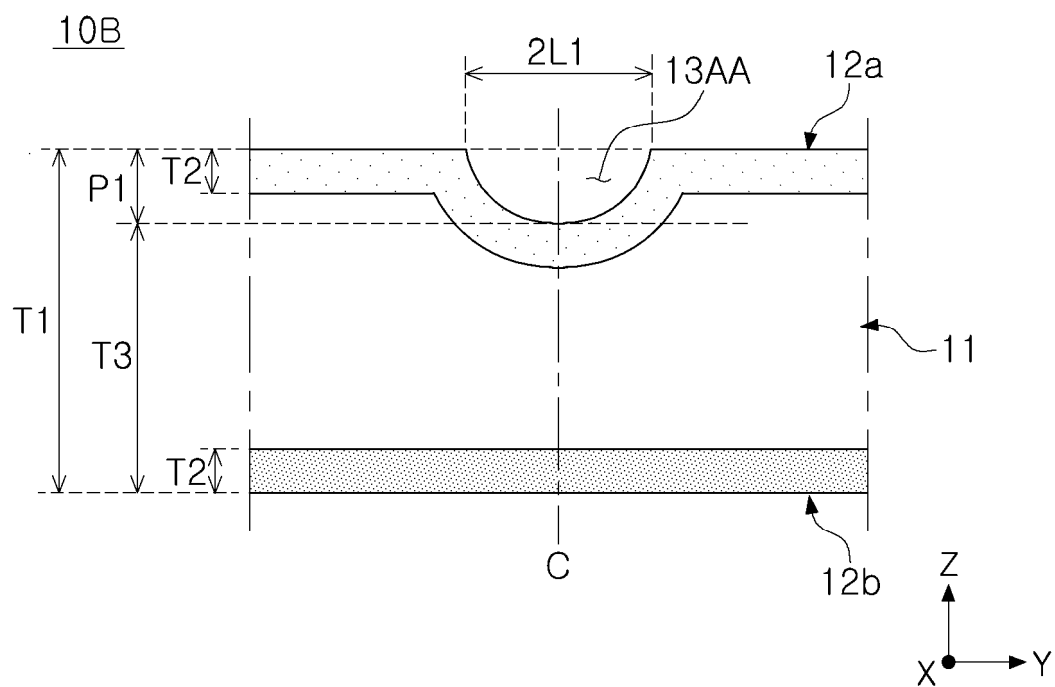


[FIG. 4]

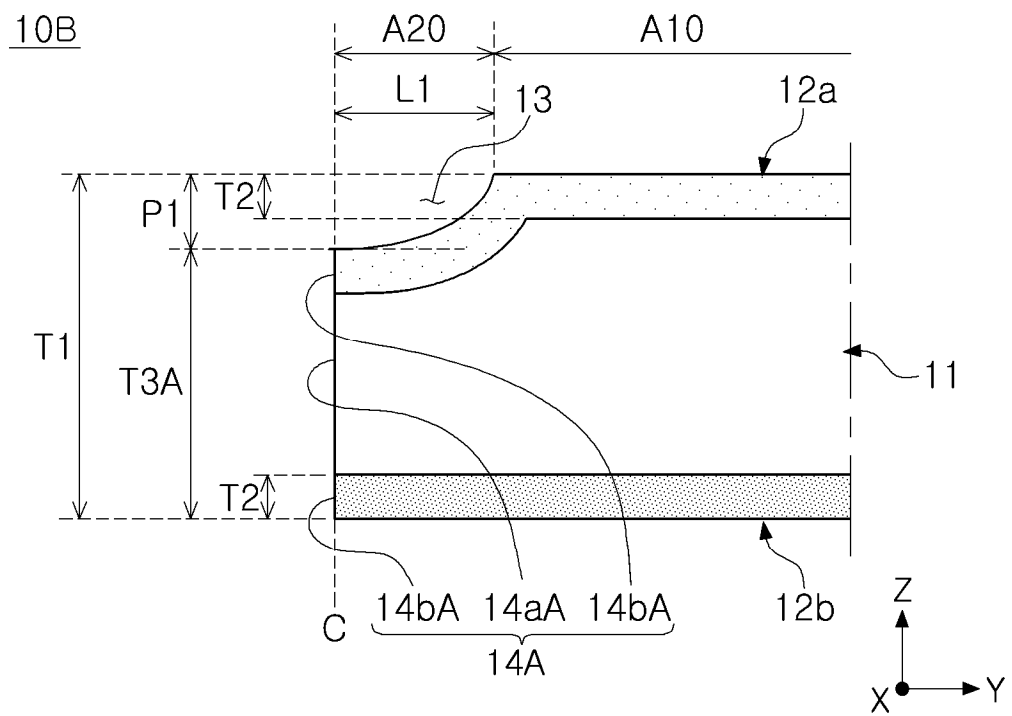
10A



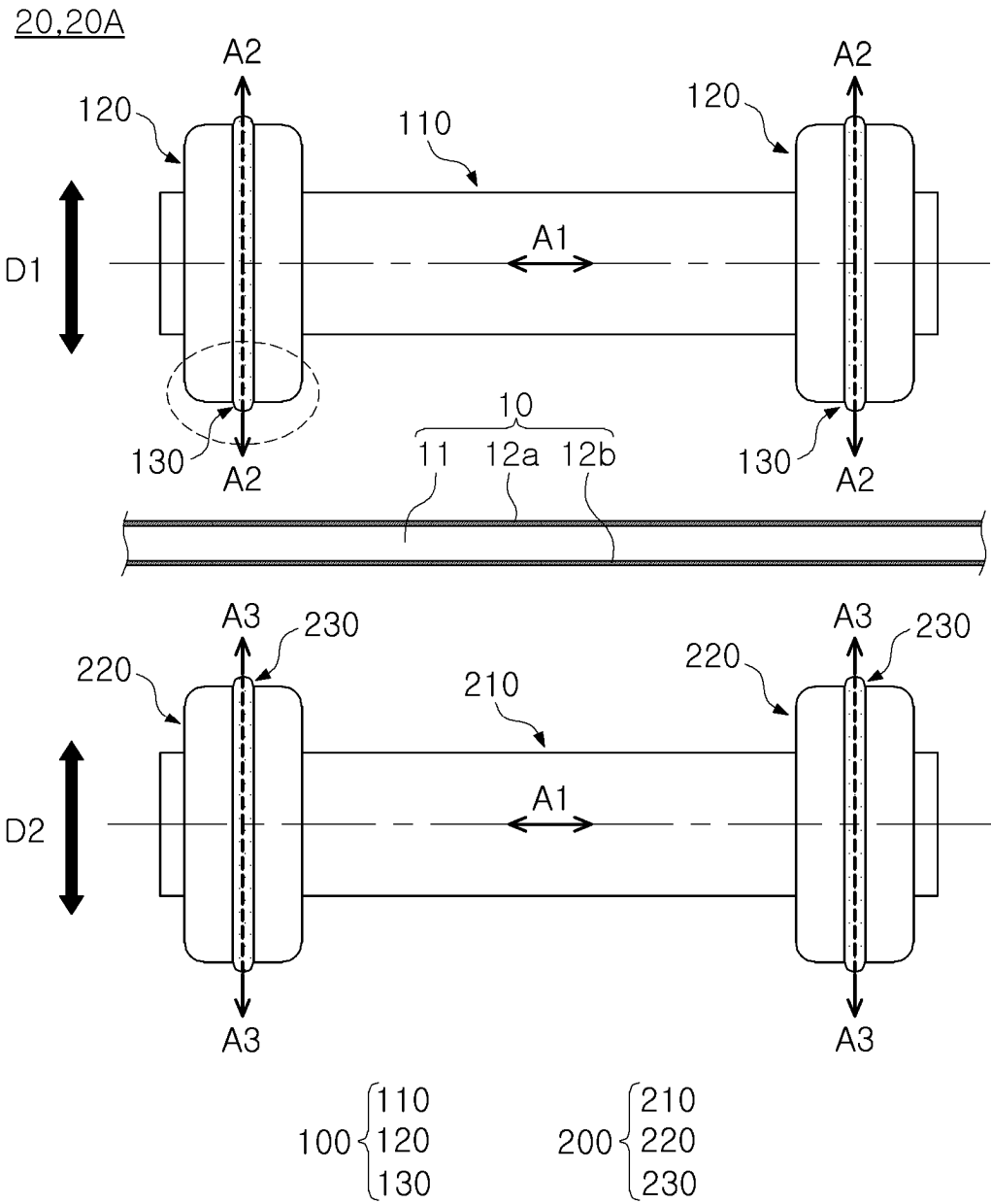
[FIG. 5a]



[FIG. 5b]

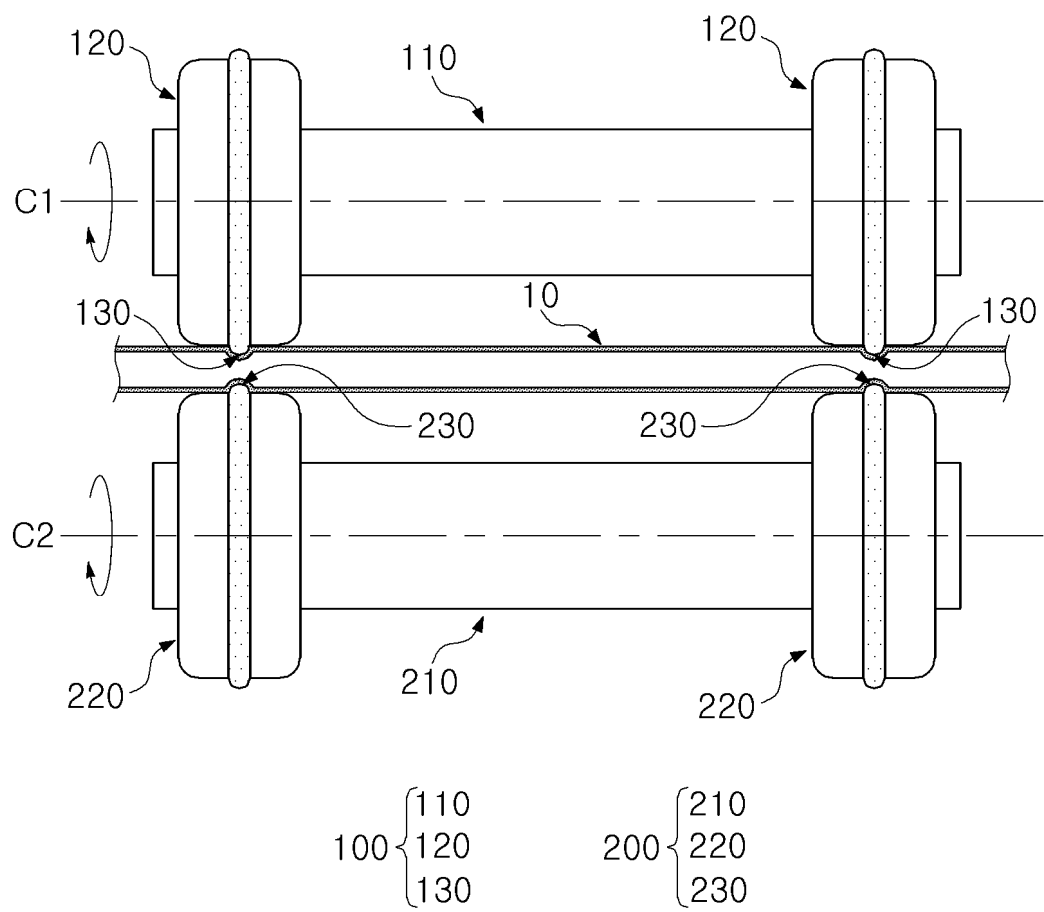


[FIG. 6]



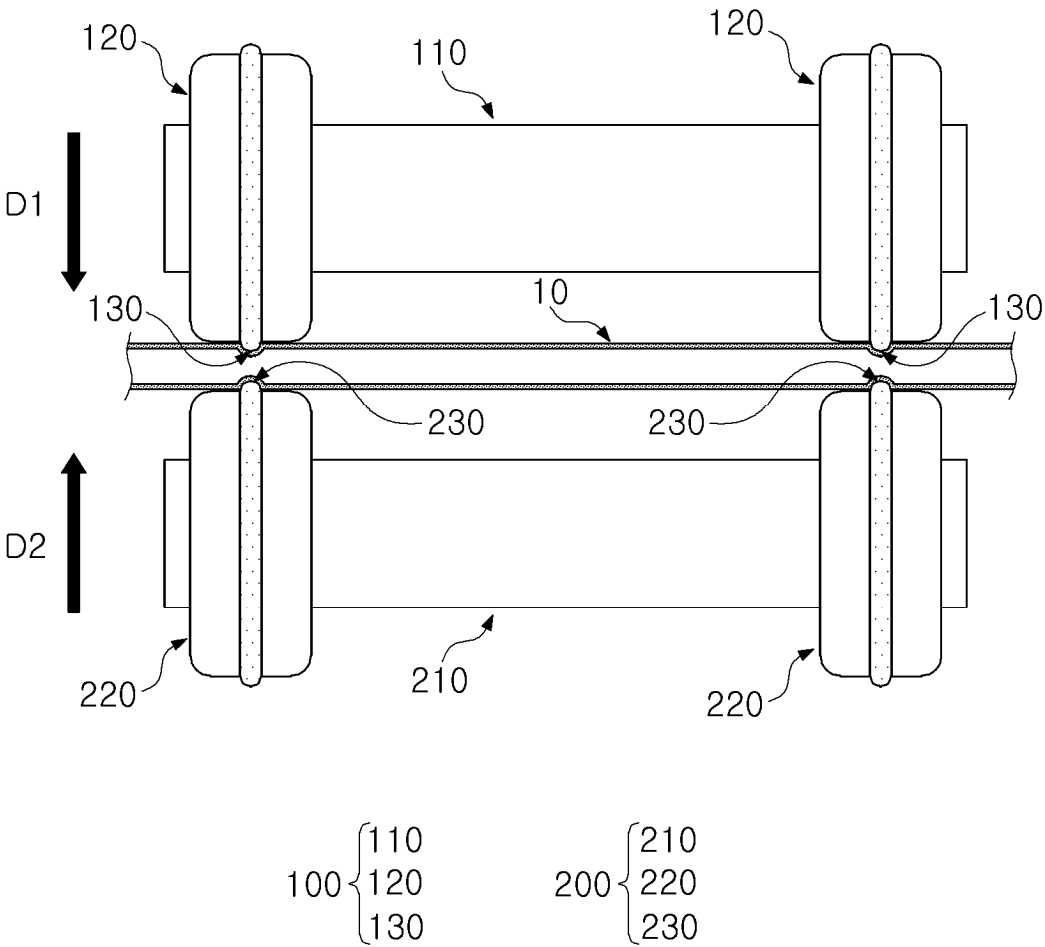
[FIG. 7]

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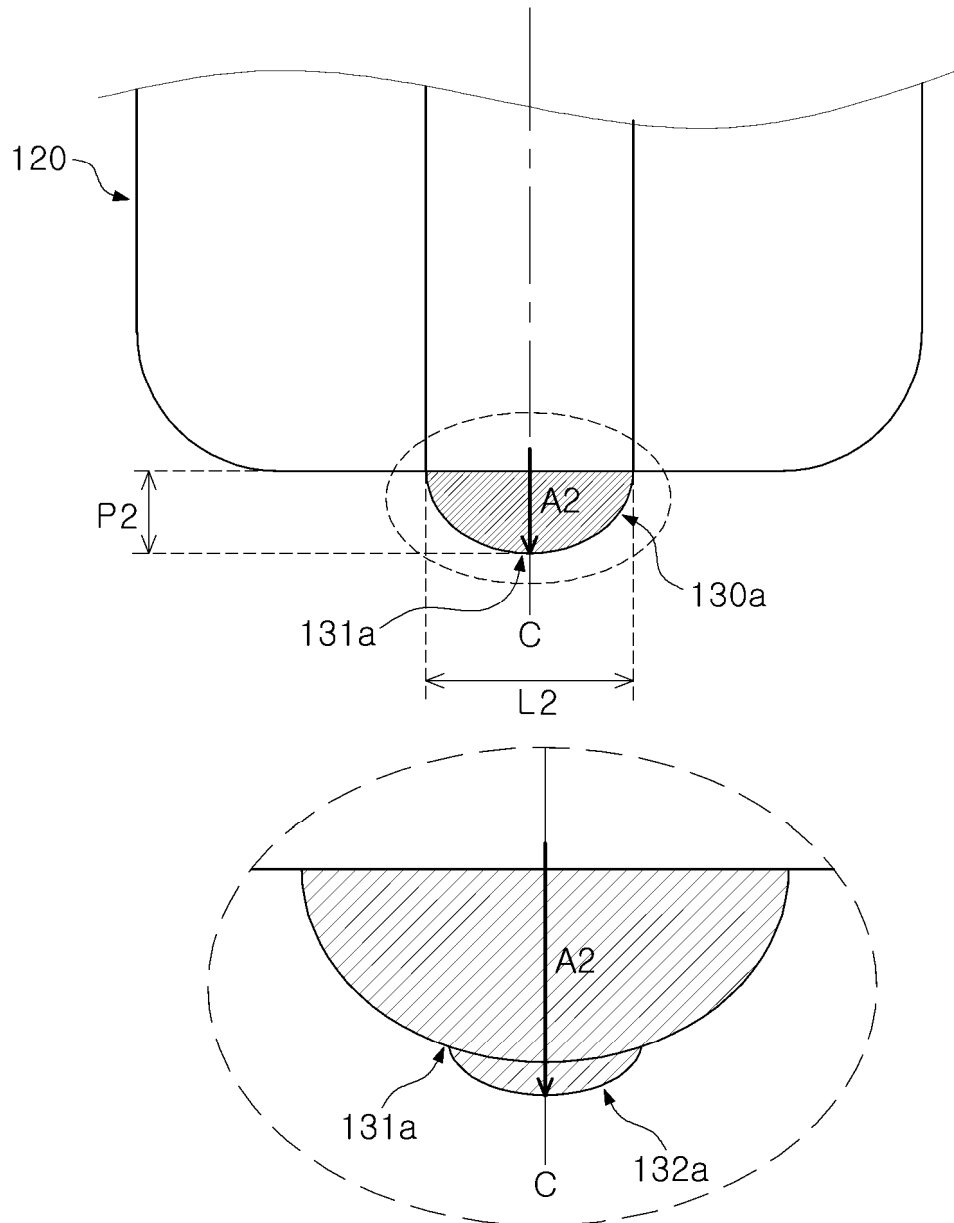


[FIG. 8]

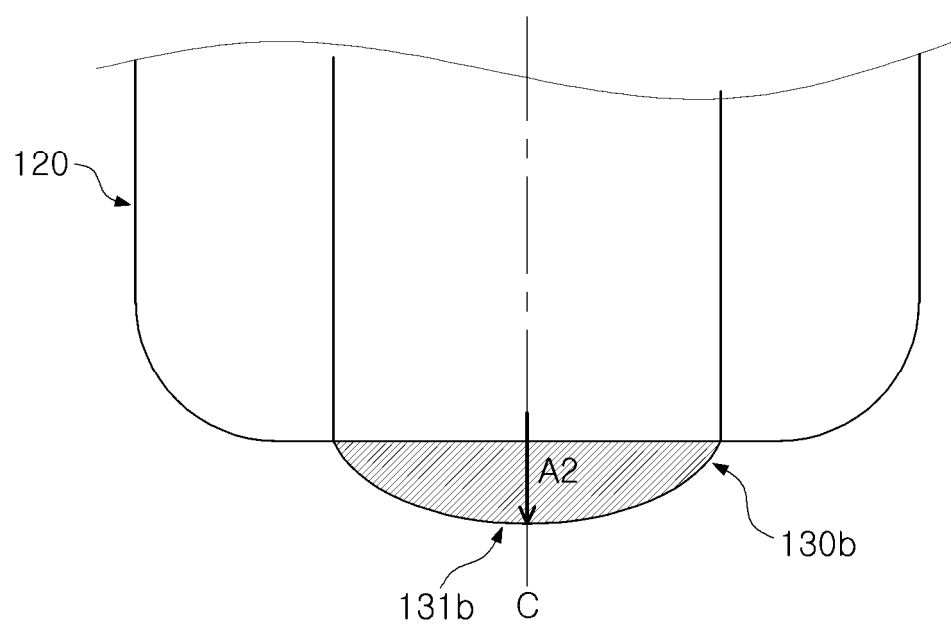
20A



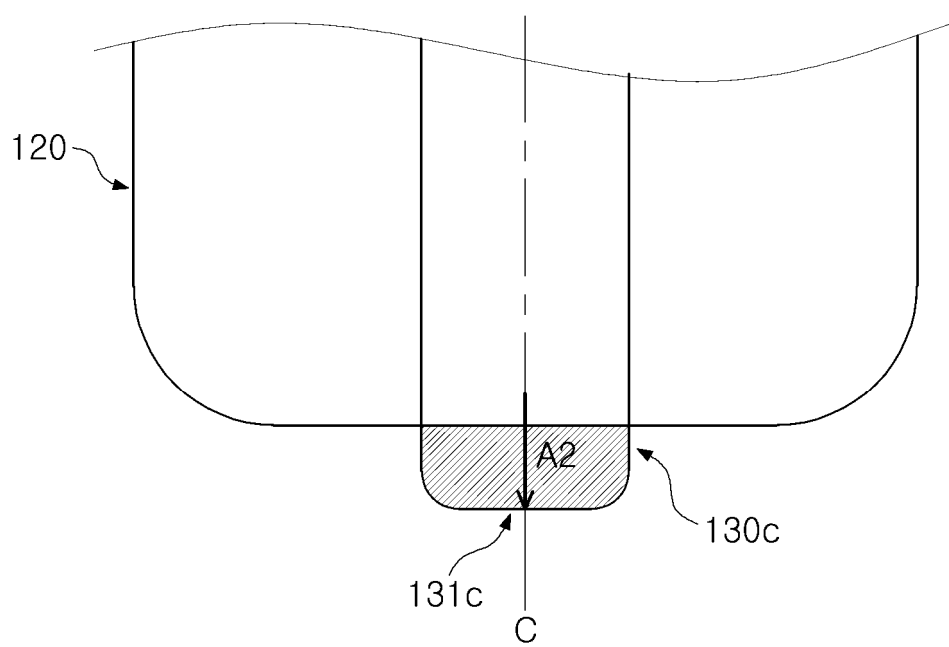
[FIG. 9]



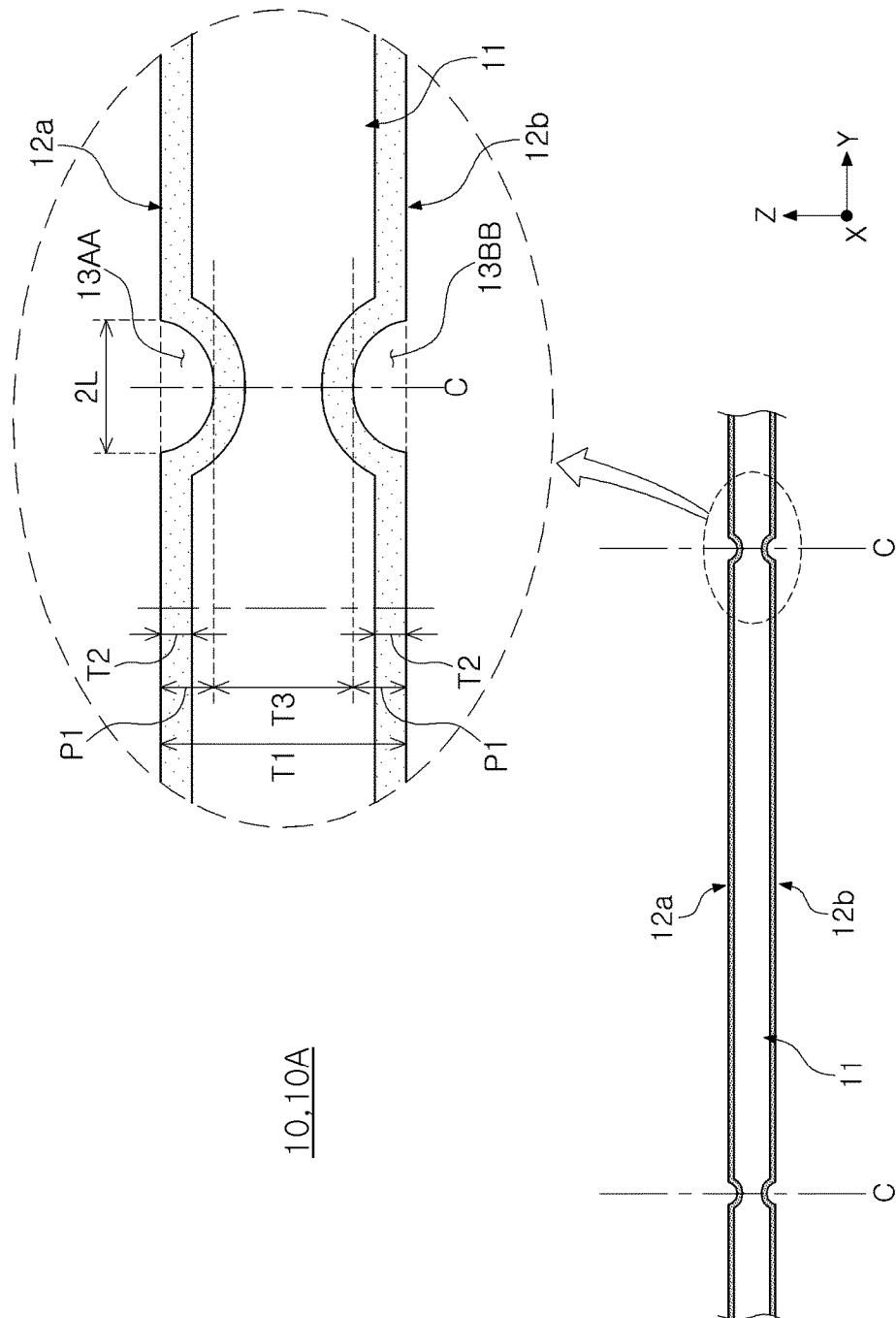
[FIG. 10a]



[FIG. 10b]

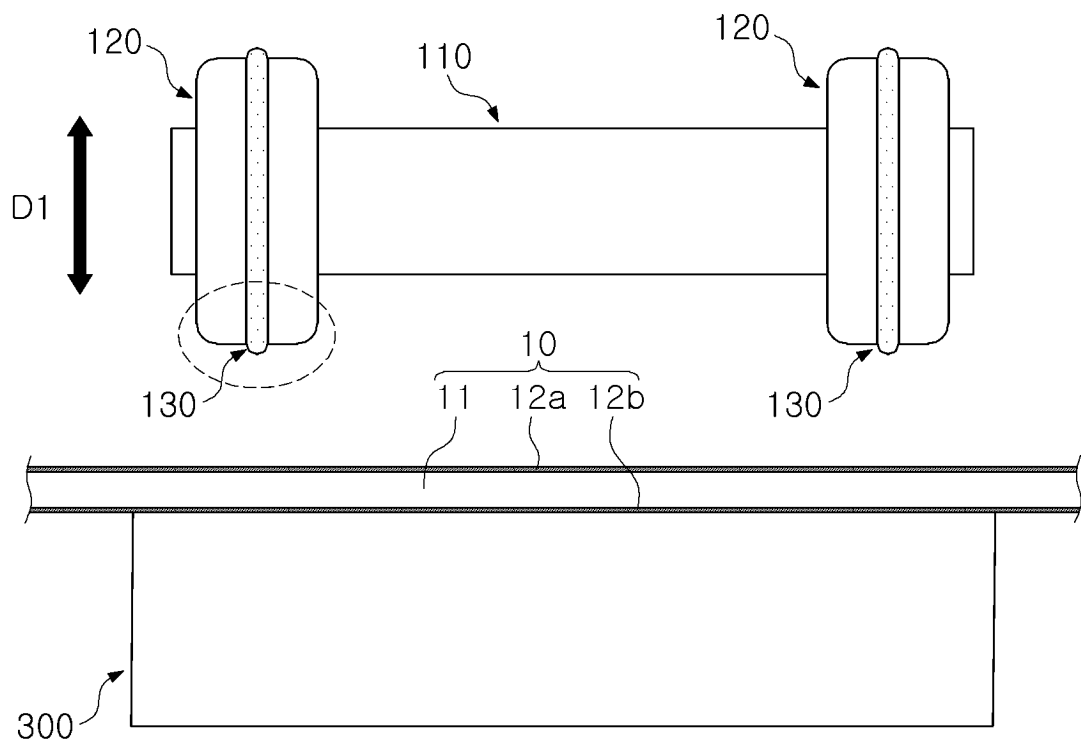


[FIG. 11]



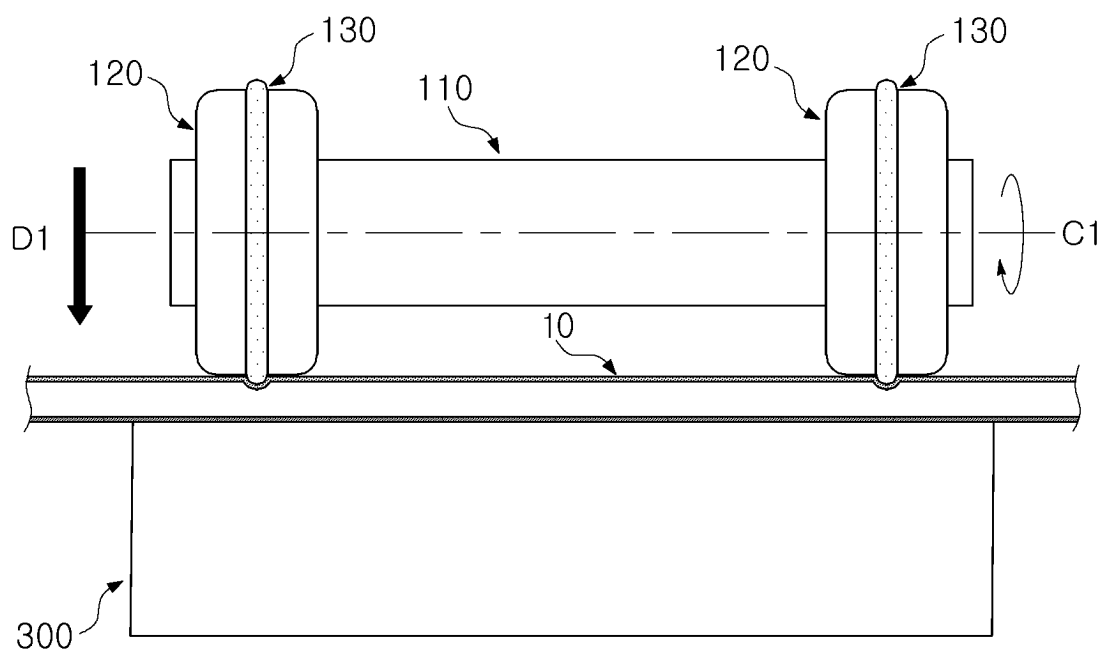
[FIG. 12]

20B

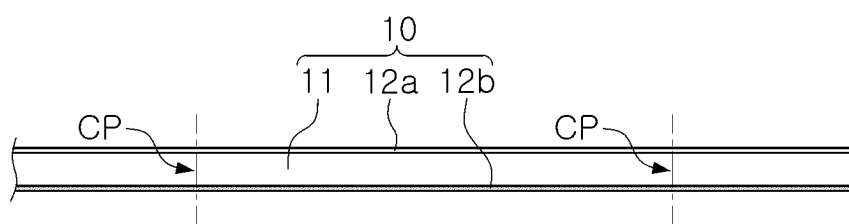


[FIG. 13]

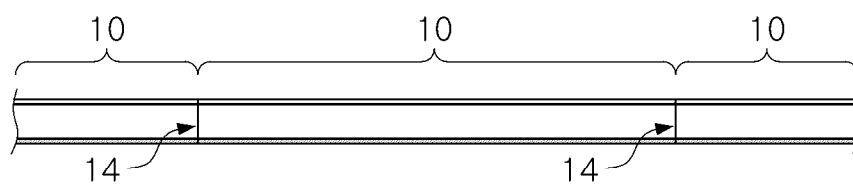
20B



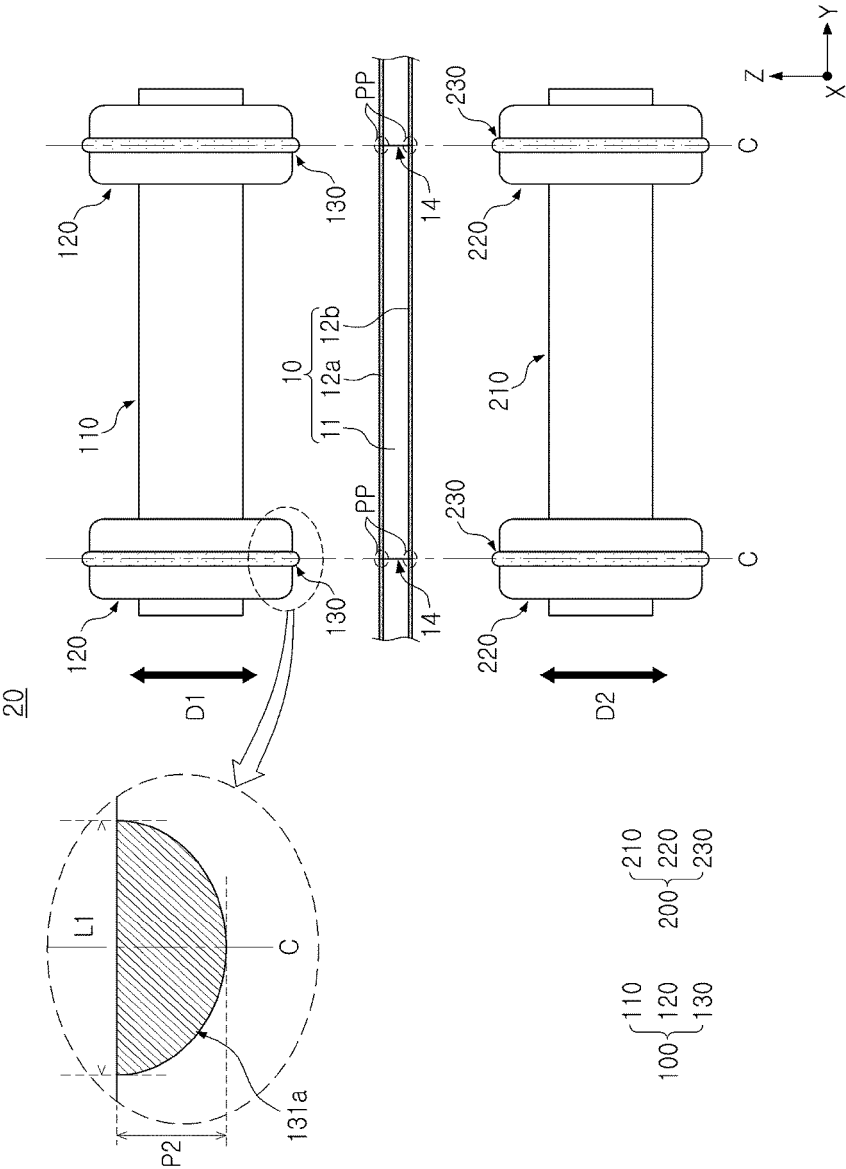
[FIG. 14a]



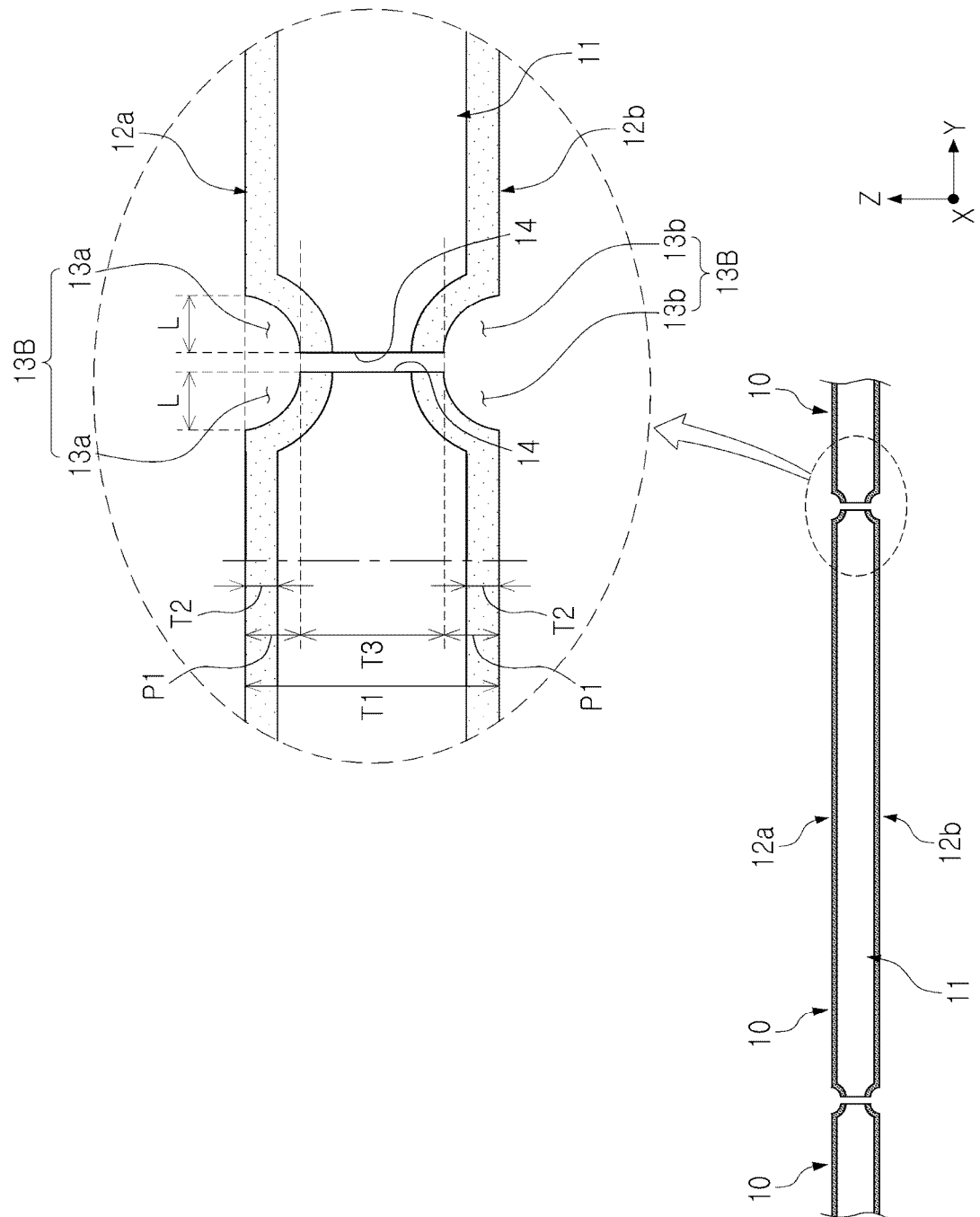
[FIG. 14b]



[FIG. 15]



[FIG. 16]



INTERNATIONAL SEARCH REPORT

International application No.

PCT/KR2024/097005

A. CLASSIFICATION OF SUBJECT MATTER

B21D 17/04(2006.01)i; **B21D 43/28**(2006.01)i; **C23C 2/40**(2006.01)i; **C25D 7/06**(2006.01)i; **C23C 2/06**(2006.01)i;
C23C 2/12(2006.01)i; **C25D 3/22**(2006.01)i; **C25D 3/44**(2006.01)i; **C23C 2/26**(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)

B21D 17/04(2006.01); B21D 19/00(2006.01); B21D 28/02(2006.01); B21D 28/14(2006.01); B21D 28/16(2006.01);
 B21D 28/26(2006.01); B23D 19/06(2006.01)

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

Korean utility models and applications for utility models: IPC as above

Japanese utility models and applications for utility models: IPC as above

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

eKOMPASS (KIPO internal) & keywords: 도금 강판(plated steel sheet), 압착(compressing), 부식(corrosion), 곡률
 (curvature), 폭(width)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	CN 102489583 A (JIANGSU SIMCOS ELECTRICAL APPLIANCES CO., LTD.) 13 June 2012 (2012-06-13) See paragraphs [0019]-[0022] and figures 1-6.	1-22
A	JP 2020-032437 A (NIPPON STEEL CORP.) 05 March 2020 (2020-03-05) See paragraphs [0028]-[0056] and figures 1-6.	1-22
A	JP 2018-075600 A (NISSHIN STEEL CO., LTD.) 17 May 2018 (2018-05-17) See paragraph [0029] and figure 1.	1-22
A	EP 3411165 B1 (BAYERISCHE MOTOREN WERKE AKTIENGESELLSCHAFT) 23 August 2023 (2023-08-23) See claims 1-10 and figures 1 and 2.	1-22
A	WO 2023-223805 A1 (NIPPON STEEL CORPORATION) 23 November 2023 (2023-11-23) See paragraphs [0022]-[0035] and figures 1-3.	1-22

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

* Special categories of cited documents:

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“O” document referring to an oral disclosure, use, exhibition or other means

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

“T” later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

“X” document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

“Y” document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

“&” document member of the same patent family

Date of the actual completion of the international search 18 March 2025	Date of mailing of the international search report 19 March 2025
Name and mailing address of the ISA/KR Korean Intellectual Property Office Government Complex-Daejeon Building 4, 189 Cheongsaro, Seo-gu, Daejeon 35208 Facsimile No. +82-42-481-8578	Authorized officer Telephone No.

Form PCT/ISA/210 (second sheet) (July 2022)

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No.

PCT/KR2024/097005

Patent document cited in search report			Publication date (day/month/year)	Patent family member(s)			Publication date (day/month/year)
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JP	2018-075600	A	17 May 2018	None			
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				CN	108290199	B	05 November 2021
				DE	102016201433	A1	03 August 2017
				EP	3411165	A1	12 December 2018
				US	11247257	B2	15 February 2022
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WO	2023-223805	A1	23 November 2023	CN	119136926	A	13 December 2024
				JP	2023-223805	A1	23 November 2023
				KR	10-2024-0168443	A	29 November 2024
				TW	202410988	A	16 March 2024