

PATENT SPECIFICATION

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(54) IMPROVEMENTS IN OR RELATING TO APPARATUS FOR AND A METHOD OF JOINING THE EDGES OF TWO SHEET PORTIONS TOGETHER

(71) We, SILO VERFAHRENS AG a Swiss Company of Hofstrasse 1, CH-6301 Zug, Switzerland, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

The present invention relates to apparatus for and methods of joining together adjacent sheet portions.

The invention is particularly but not exclusively concerned with the joining of plastically deformable metal sheet, in which one of the edges has two spaced bends each of about 90° and each made in the same direction, and the other edge additionally has an approximately 90° bend made in the opposite direction and situated farther away from the end of the plate, so that the edges are each formed with a U-shaped section.

When two abutting edges are connected by folding it has been found that when the previously bent arm of one U is folded over an arm of the other U, the first arm springs back after the folding operation during which the fold should be compressed, and at least obstructs the compression of the fold. It was therefore necessary to include an additional operation to bring the first arm into a position in which it cannot obstruct the next operation by springing back.

According to one aspect of the present invention, there is provided apparatus for connecting together abutting edge portions of two sheets each of which sheets is formed at its edge portion with a substantially U-shaped section, comprising means adapted to receive the edge portions with one U-shaped section received within the other U-shaped section and having a base substantially at right angles to the base of the other U-shaped section, said means including first deforming means for bending in one arm of said other U-shaped section towards one arm of said one U-shaped section, and second deforming means,

to which the edge portions pass after said first deforming means, comprising two deforming members one of which has a tapered projection, said second deforming means being operative to bend the other arm of the other U-shaped section and the base of the one U-shaped section so as to reduce the angle between this other arm and the base and the base of the other U-shaped section while simultaneously bringing into parallelism the said one arms of the two U-shaped sections.

According to another aspect of the invention there is provided a method of connecting together abutting edge portions of two sheets each of which sheets is formed at its edge portion with a U-shaped section and with the U-shaped section of one portion received within and having a base substantially at right angles to the base of the other U-shaped section, including the steps of bending one arm of the other U-shaped section in towards one arm of the one U-shaped section using first deforming means then using second deforming means to which the edge portions pass after the first deforming means, bending the other arm of the other U-shaped section and the base of the one U-shaped section so as to reduce the angle between this arm and base and the base of the other U-shaped section while simultaneously bringing into parallelism said one arms of the two sections.

The invention may be performed in various ways and one specific embodiment will now be described by way of example with reference to the accompanying drawings, in which:—

Figure 1 is a side elevation of one embodiment of apparatus for connecting together two sheet portions;

Figure 2 shows the edges of the two sheets in the starting conditions first before entering the apparatus of Figure 1;

Figure 3 is a section on the line III—III of Figure 1 with inserted sheets prepared in accordance with Figure 2; and

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Figures 4 to 6 are respectively sections on the lines IV—IV, V—V and VI—VI in Figure 1 showing the formation of the sheets on those sections.

5 Referring to the drawings, four pairs of rollers 2-9 are mounted in a frame 1 so as to be vertically adjustable and rotatable. The two rollers of each pair are positively connected to each other by gearwheels. One
10 roller of each pair is adapted to be driven from the adjacent pair by means of a chain, each chain connecting only two adjacent pairs of rollers. One of the gearwheels connected to the rollers 2-9 so as to rotate
15 therewith is connected to a drive motor so as to be driven therefrom. The rollers 2-9 are thus each adapted to be driven at the same speeds.

20 Referring to Figure 2, which shows a cross-section of two metal sheets 11 and 12, which are to be connected together, the sheet 11 has three bends 13—15, each made through an angle of 90°, the bends 14 and 15 being made in the same direction and the
25 bend 13 being made in the opposite direction thereto. The sheet 12 has two bends 16 and 17 each made through 90° in the same direction. The bends 13, 14 and 16, 17 and preferably also 14, 15 are equidistant from one another. The free ends
30 of the sheets 11 and 12 bear the references 18 and 19 and the zones between the bends bear the references 21, 22 and 23 respectively. The lengths of the free ends are somewhat shorter than the distances
35 between the bends 13, 14, 16, 17 and 14, 15 respectively. By bending the sheets in this way, the edge portion of each sheet is formed with a U-shaped section. In the case of sheet 12, however, the upright axis of the U is parallel to the plane of the sheet; whereas in the case of sheet 11 the upright
40 axis of the U is perpendicular to the plane of the sheet 11. With the exception of the bends, the sheets 11 and 12 may be flat or be curved about an axis extending in parallel relationship to the U bends. Alternatively, the sheets 11, 12 having the bends 13-17 may be rotated about an axis at right angles to the zones 21 and 23 in Figure 2 during the
45 folding together of their edges 19, 21, 22 and 18, 23 as shown in Figures 3-6. In a finished tube, the finished fold may therefore extend in parallel relationship to the tube longitudinal axis, in the form of a ring around its periphery, or in the form of a helix on its periphery if the pairs of rollers are disposed in a helix.

60 The free end 19 is bent through an angle of between 15° and 80°, more particularly between 30° and 60°, by means of the rollers 2, 3. To this end, the roller 3 has an annular groove 27 which is disposed between two flanges and which has an inclined wall 28 and a wall 29 extending at right angles to the

axis of rotation of the roller. The roller 2 is of cylindrical construction.

During the next operation, as shown in Figure 4, the free end 19 is applied against the free end 18 and the zones 21, 23 are simultaneously bent through an angle of between 15° and 75°, more particularly between 30° and 60°, in the direction of the sheet 11. To this end, the roller 4 has an annular groove 30 with an inclined wall 31 and with a wall 32 extending at right angles to the axis of rotation of the roller the wall 31 abutting the zone 21 and the wall 32 abutting the zone 22.

The roller 5 has an annular projection 33, an inclined surface 34 of which abuts the zone 23 and a wall 35 of which at right angles to the axis abuts the free end 19. The rollers 4 and 5 also have flanges 36 and 37, of which the flange 36 has the wall 32 abutting the zone 22 and bounding the annular groove 30.

As a result of the bending of the zone 23, the free end 19 engages in an acute angle and is therefore prevented from springing back. The wall 32 also ensures that when the free end 19 is bent in by the roller 5 the zone 22 is not pressed in the direction of the roller 4.

The pair of rollers 6, 7 serves to place the free ends 18, 19 in parallel relationship and the zone 22 in parallel relationship to the zones 21 and 23, and to apply the free end 19 against the zone 23. To this end, the roller 6 has an annular groove 41 which has an inclined wall 42 and the roller 7 has an annular bead 43 which cooperates with the annular groove 41 and which has a corresponding inclined wall 44. The rollers 6 and 7 also have annular flanges 45 and 46.

In the next operation, the cylindrical rollers 8 and 9 cause the fold to be disposed at right angles to the sheets 11 and 12.

While the annular groove 27 of the roller 3 is situated on one side of the parts 18, 19, 21, 22, 23 being processed, the annular grooves 30 and 41 of the rollers 4 and 6 are situated on the other side.

Instead of the rollers, stamping tools or the like may be used to form the sheet-metal edges. If only stamping tools are used for forming the sheet-metal edges, feed rolls are additionally required.

WHAT WE CLAIM IS:—

1. Apparatus for connecting together abutting edge portions of two sheets each of which sheets is formed at its edge portion with a substantially U-shaped section, comprising means adapted to receive the edge portions with one U-shaped section received within the other U-shaped section and having a base substantially at right angles to the base of the other U-shaped section, said means including first deforming means

Figures 4 to 6 are respectively sections on the lines IV—IV, V—V and VI—VI in Figure 1 showing the formation of the sheets on those sections.

Referring to the drawings, four pairs of rollers 2-9 are mounted in a frame 1 so as to be vertically adjustable and rotatable. The two rollers of each pair are positively connected to each other by gearwheels. One roller of each pair is adapted to be driven from the adjacent pair by means of a chain, each chain connecting only two adjacent pairs of rollers. One of the gearwheels connected to the rollers 2-9 so as to rotate therewith is connected to a drive motor so as to be driven therefrom. The rollers 2-9 are thus each adapted to be driven at the same speeds.

Referring to Figure 2, which shows a cross-section of two metal sheets 11 and 12, which are to be connected together, the sheet 11 has three bends 13-15, each made through an angle of 90° , the bends 14 and 15 being made in the same direction and the bend 13 being made in the opposite direction thereto. The sheet 12 has two bends 16 and 17 each made through 90° in the same direction. The bends 13, 14 and 16, 17 and preferably also 14, 15 are equidistant from one another. The free ends of the sheets 11 and 12 bear the references 18 and 19 and the zones between the bends bear the references 21, 22 and 23 respectively. The lengths of the free ends are somewhat shorter than the distances between the bends 13, 14, 16, 17 and 14, 15 respectively. By bending the sheets in this way, the edge portion of each sheet is formed with a U-shaped section. In the case of sheet 12, however, the upright axis of the U is parallel to the plane of the sheet; whereas in the case of sheet 11 the upright axis of the U is perpendicular to the plane of the sheet 11. With the exception of the bends, the sheets 11 and 12 may be flat or be curved about an axis extending in parallel relationship to the U bends. Alternatively, the sheets 11, 12 having the bends 13-17 may be rotated about an axis at right angles to the zones 21 and 23 in Figure 2 during the folding together of their edges 19, 21, 22 and 18, 23 as shown in Figures 3-6. In a finished tube, the finished fold may therefore extend in parallel relationship to the tube longitudinal axis, in the form of a ring around its periphery, or in the form of a helix on its periphery if the pairs of rollers are disposed in a helix.

The free end 19 is bent through an angle of between 15° and 80° , more particularly between 30° and 60° , by means of the rollers 2, 3. To this end, the roller 3 has an annular groove 27 which is disposed between two flanges and which has an inclined wall 28 and a wall 29 extending at right angles to the

axis of rotation of the roller. The roller 2 is of cylindrical construction.

During the next operation, as shown in Figure 4, the free end 19 is applied against the free end 18 and the zones 21, 23 are simultaneously bent through an angle of between 15° and 75° , more particularly between 30° and 60° , in the direction of the sheet 11. To this end, the roller 4 has an annular groove 30 with an inclined wall 31 and with a wall 32 extending at right angles to the axis of rotation of the roller the wall 31 abutting the zone 21 and the wall 32 abutting the zone 22.

The roller 5 has an annular projection 33, an inclined surface 34 of which abuts the zone 23 and a wall 35 of which at right angles to the axis abuts the free end 19. The rollers 4 and 5 also have flanges 36 and 37, of which the flange 36 has the wall 32 abutting the zone 22 and bounding the annular groove 30.

As a result of the bending of the zone 23, the free end 19 engages in an acute angle and is therefore prevented from springing back. The wall 32 also ensures that when the free end 19 is bent in by the roller 5 the zone 22 is not pressed in the direction of the roller 4.

The pair of rollers 6, 7 serves to place the free ends 18, 19 in parallel relationship and to zone 22 in parallel relationship to the zones 21 and 23, and to apply the free end 19 against the zone 23. To this end, the roller 6 has an annular groove 41 which has an inclined wall 42 and the roller 7 has an annular bead 43 which cooperates with the annular groove 41 and which has a corresponding inclined wall 44. The rollers 6 and 7 also have annular flanges 45 and 46.

In the next operation, the cylindrical rollers 8 and 9 cause the fold to be disposed at right angles to the sheets 11 and 12.

While the annular groove 27 of the roller 3 is situated on one side of the parts 18, 19, 21, 22, 23 being processed, the annular grooves 30 and 41 of the rollers 4 and 6 are situated on the other side.

Instead of the rollers, stamping tools or the like may be used to form the sheet-metal edges. If only stamping tools are used for forming the sheet-metal edges, feed rolls are additionally required.

WHAT WE CLAIM IS:—

1. Apparatus for connecting together abutting edge portions of two sheets each of which sheets is formed at its edge portion with a substantially U-shaped section, comprising means adapted to receive the edge portions with one U-shaped section received within the other U-shaped section and having a base substantially at right angles to the base of the other U-shaped section, said means including first deforming means



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5 for bending in one arm of said other U-shaped section towards one arm of said one U-shaped section, and second deforming means, to which the edge portions pass after said first deforming means, comprising two deforming members one of which has a tapered projection, said second deforming means being operative to bend the other arm of the other U-shaped section and the base of the one U-shaped section so as to reduce the angle between this other arm and the base and the base of the other U-shaped section while simultaneously bringing into parallelism the said one arms of the two U-shaped sections.
10 2. Apparatus as claimed in claim 1, in which the first deforming means comprises two deforming members one of which has a groove having an inclined side operative to perform said bending in action.
15 3. Apparatus as claimed in claim 1 or claim 2, in which the other deforming member of the second deforming means has a groove having an inclined side and said tapered projection is aligned with said groove.
20 4. Apparatus as claimed in claim 1, or claim 2, or claim 3, in which third deforming means are provided comprising two deforming members one of which comprises a groove and the other of which comprises a tapered projection aligned with the groove, said members co-acting to bring into parallelism the bases and arms of the U-shaped sections except for the other arm of the one section.
25 5. Apparatus as claimed in claim 1 or claim 2 or claim 3, in which third deforming means are provided comprising two deforming members, each having a surface inclined with respect to the base of the one edge portion in the first deforming means, the inclined surfaces being parallel, the two deforming members co-acting to bring into parallelism the bases and arms of the U-shaped sections except for the other arm of the one section.
30 6. Apparatus as claimed in any one of the preceding Claims in which fourth deforming means are provided comprising two members which coact with each other to displace the parallel bases and arms until they are substantially at right angles to the remainder of sheets at the joint.
35 7. Apparatus as claimed in any preceding claim, in which each deforming means comprise rollers disposed for rotation about substantially parallel axes.
40 8. Apparatus as claimed in claim 7 when appendant to claim 3 in which one roller of the second deforming means includes a projection extending round the cylindrical periphery of the roller, and the groove, which also extends round the cylindrical periphery of the one roller, is defined
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between this projection and a further peripheral projection which has said inclined side on the groove side thereof.
9. Apparatus as claimed in Claim 8, wherein the tapered projection of the other roller of the second deforming means extends round the cylindrical periphery of the roller and the roller comprises a further projection, a groove being defined between the two projections of the other roller into which the first mentioned projection of the said one roller extends, and the tapered projection of this other roller extending into the groove of the said one roller.
10. Apparatus as claimed in claim 7 when appendant to claim 4, in which the groove, which extends around the cylindrical periphery of the roller of the third deforming means has one inclined side substantially aligned with, but spaced away from, an inclined side of the tapered member, which extends around the periphery of the other roller, the spacing being such as to accommodate the aligned bases and arms of the U-shaped sections.
11. Apparatus as claimed in any preceding claim, in which the members of each deforming means are adjustable relative to each other.
12. Apparatus as claimed in any preceding claim, in which the members of each deforming means are geared together.
13. Apparatus as claimed in any preceding claim, in which the deforming means are adjacent and one of the members of each deforming means is connected to one of the members of the adjacent deforming means by a chain drive.
14. A method of connecting together abutting edge portions of two sheets each of which sheets is formed at its edge portion with a U-shaped section and with the U-shaped section of one portion received within and having a base substantially at right angles to the base of the other U-shaped section, including the steps of bending one arm of the other U-shaped section in towards one arm of the one U-shaped section using first deforming means, then using second deforming means to which the edge portions pass after the first deforming means bending the other arm of the other U-shaped section and the base of the one U-shaped section so as to reduce the angle between this arm and base and the base of the other U-shaped section while simultaneously bringing into parallelism said one arms of the two sections.
15. A method as claimed in claim 14, in which the one arm of the other U-shaped section is bent in through an angle of between 15° and 80°.
16. A method as claimed in claim 14 or claim 15, in which the other arm and the

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base are bent through an angle of between 15° and 75°.

17. A method as claimed in any one of claims 14 to 16, in which the one arm of the two sections and the base of the other section are brought into parallelism with the other arm of the other section and the base of the one section.

18. A method as claimed in claim 17, in which the parallel bases and one arm of the two sections and the other arm of the other section are brought to position at right angles to the other arm of said one section.

19. Apparatus for connecting together abutting edge portions of two sheets substantially as hereinbefore described with reference to the accompanying drawings.

20. A method of connecting together abutting edge portions of two sheets substantially as hereinbefore described.

Agents for the Applicants:
WILSON, GUNN & ELLIS,
Chartered Patent Agents,
41 Royal Exchange,
M2 7DB.

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