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(54) Method and apparatus for curving longitudinal sheets having two opposite flanges

(57) The invention relates to a method for curving a longitudinal metal sheet having a substantially flat portion with two opposite flanges along its sides.

According to the method, both flanges are pressurised at spots that are symmetrically situated opposite to each other, the pressure being successively exerted from the beginning to the end of the sheet to be curved, and in which the sheet is successively forced to bend in the section where the pressurised spots are present.

The invention also relates to an apparatus for curving a longitudinal metal sheet having a substantially flat portion with two opposite flanges along its sides.

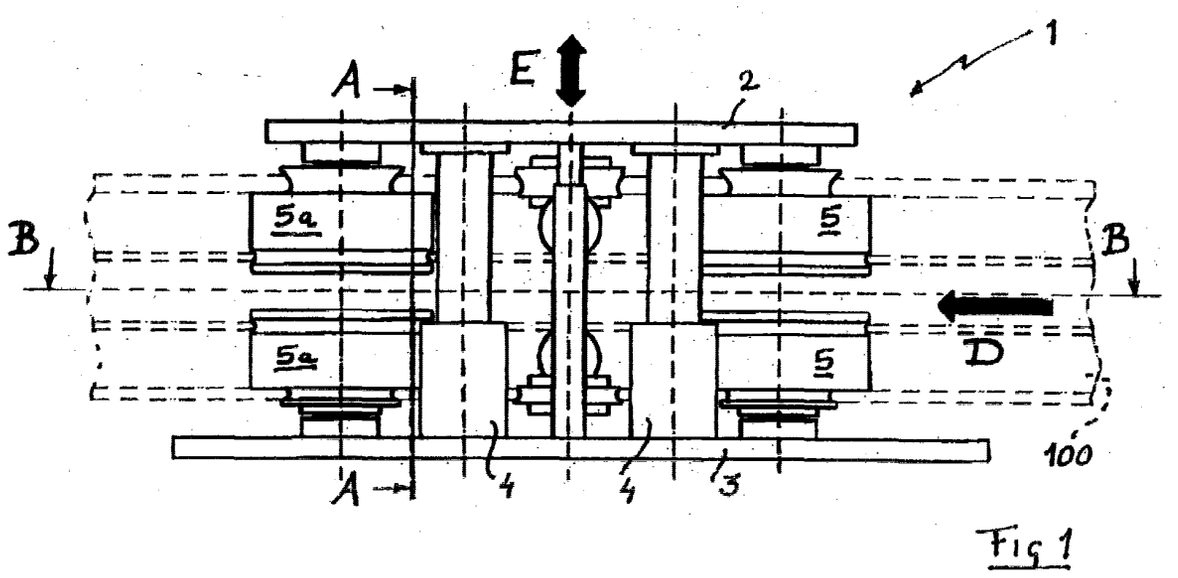

Fig 1

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Description

[0001] The invention relates to a method for curving a longitudinal metal sheet having a substantially flat portion with two opposite flanges along its sides. The invention also relates to an apparatus for curving a longitudinal metal sheet having a substantially flat portion with two opposite flanges along its sides.

[0002] Nowadays many buildings, and especially the roofs hereof, are constructed from metal panels. The sides of the metal panels are bent upwards as opposite flanges, to form standing seams which are slidably attached to retaining clips.

[0003] Modern buildings are often formed with curved roofs or walls, and therefore the longitudinal metal sheets with flanges must be curved. However, because of the flanges it is difficult to curve the sheets, as the flanges could crack or fold, depending on the curving direction (convex or concave).

[0004] It is an objective of the invention to provide a method and apparatus with which longitudinal metal sheets having a substantially flat portion with two opposite flanges can be curved in a simple and fast manner.

[0005] It is another objective of the invention to provide such a method and apparatus with which it is possible to curve such a metal sheet in both a convex and a concave form.

[0006] It is still another objective of the invention to provide such a method and apparatus which can be used on the site where a building is erected.

[0007] It is yet another objective to provide such a method and apparatus which is easy to use and cheap.

[0008] According to a first aspect of the invention, one or more of these objectives is reached with a method for curving a longitudinal metal sheet having a substantially flat portion with two opposite flanges along its sides, in which both flanges are pressurised at spots that are symmetrically situated opposite to each other, the pressure being successively exerted from the beginning to the end of the sheet to be curved, and in which the sheet is successively forced to bend in a section where the pressurised spots are present.

[0009] Due to the pressure on the flanges, the metal at those spots becomes more or less fluidized, as a result of which it is relatively easy to deform the metal at these spots. The flanges at the fluidized spots can than easily be lengthened or shortened, and by doing so over the full length of the sheet to be curved the sheet is curved in a convex or concave form.

[0010] According to a second aspect of the invention, one or more of the above objectives is reached with an apparatus for curving a longitudinal metal sheet having a substantially flat portion with two opposite flanges along its sides, the apparatus comprising pressure means for pressurising the flanges of the sheet at spots that are symmetrically situated opposite to each other, bending means at both sides of the pressure means, and transport means for moving the sheet relative to the apparatus.

[0011] With this apparatus, pressure means are provided to pressurise the flanges at opposite spots, so the metal will become more or less fluidized at those spots, and the bending means will bend the metal sheet in convex or concave direction while the transport means move the sheet relative to the apparatus. Thus, the metal sheet will be curved in a simple and fast manner. Due to the fluidisation of the metal, the metal sheet can be given a convex or concave form, as required.

[0012] Preferably, the pressure means comprise pressure rolls that are provided at both sides of each flange. By using pressure rolls, pressure can be exerted on the flanges in a simple way, and the pressure rolls can simply roll over the flanges of the sheet as the sheet is moved relative to the apparatus. The pressure rolls press on a small spot, so the pressure is high and the can be easily controlled.

[0013] So as to form a standing seam on a roof from two sheets with adjacent flanges, the flanges often end in outward-bent rims that fit over the retaining clips. For curving such sheets, the pressure means comprise a pressure roll at the outside of each flange, a pressure roll at the inside of each flange, and a pressure roll at the outside of each rim. In this way, a flange is pressurised between both the outside pressure roll and the inside pressure roll, and the outside pressure roll and the rim pressure roll.

[0014] According to a preferred embodiment, the apparatus comprises a top plate for the pressure rolls for one flange, a bottom plate for the pressure rolls for the other flange, and connecting bars between the top and bottom plate. In this way, a compact and stiff apparatus is provided, making it possible to exert a high pressure on the flanges.

[0015] Preferably, the connecting bars are adjustable, so it is possible to curve flanged sheets with different widths.

[0016] According to a preferred embodiment, the transport means comprise movement rolls that fit over both longitudinal sides of the sheet, at both sides of the pressure means. The flanges and adjacent strips of the central portion of the metal sheet are thus clamped between the movement rolls, and rotation of the movement rolls will transport the metal sheet through the apparatus.

[0017] Preferably, the movement rolls at one side of the pressure means are adjustable sideways to the transport direction of a sheet relative to the apparatus, in which these movement rolls can function as bending means during use. By adjusting the adjustable movement rolls the radius of the curve of the metal sheet can be set as required for each specific building.

[0018] Preferably, the movement rolls have been rotatably connected to the top and bottom plate. When the distance between the top and bottom plate is adjusted, the movement rolls remain in the right place to clamp the flanges of the metal sheet.

[0019] According to a preferred embodiment, the apparatus comprises control means for controlling the pressure of the pressure means, the transport velocity of the transport means, and the degree of bending by the bending means. Using the control means, the required pressure for a certain metal sheet, the curvature and the velocity can be easily given, and all these functions can be kept in hand. Also, the control means can change the radius of the curvature during the operation, if this is necessary for the building for which the sheet is needed.

[0020] The invention will be elucidated referring to an exemplary embodiment, in view of the accompanying drawing.

[0021] Fig. 1 show the apparatus according to the invention schematically in front view.

[0022] Fig. 2 shows the apparatus according to fig. 1 in vertical cross section along line A - A.

[0023] Fig. 3 shows the apparatus according to fig. 1 in horizontal cross section along line B - B.

[0024] Fig. 4 shows a metal sheet with flanges and rims in cross-section.

[0025] Fig. 1 shows the apparatus 1 according to the invention in front view, and Fig. 2 and Fig. 3 show apparatus 1 in vertical and horizontal cross section, respectively. In Fig. 1 and 3 a longitudinal metal sheet 100 is shown in ghost lines, and Fig. 4 shows this sheet 100 in cross section, the sheet having a substantially flat portion 101, two flanges 102 and a rim 103 at the end of each flange 102.

[0026] The apparatus 1 has a top plate 2, a bottom plate 3 and adjustable connecting bars 4. To both the top and the bottom plate two movement rolls 5, 5a and two movement rolls 6, 6a are rotatably attached, which rolls co-operate in pairs 5, 6; 5a, 6a to clamp a side of a metal sheet 100 between them.

[0027] In between the pairs of movement rolls 5, 6; 5a, 6a pressure rolls 8, 9 and 10 are present for each flange with rim of a metal sheet 100, as is best seen in Fig. 2. An outer pressure roll 8 supports the flange 102 with rim 103 and an adjacent portion of the flat portion 101 of the metal sheet 100. (For reasons of clarity, the metal sheet is not shown in Fig. 2.) The pressure rolls 8 are rotatably attached to the top and bottom plate, respectively. The pressure rolls 9 and 10 are supported by bearing shafts (not shown), with which it is possible to press the rolls 9 and 10 against the flanges and rims of the metal sheet which is supported by the rolls 8.

[0028] The bars 4 are adjustable in height, so the top plate 2 is moveable in direction E so as to change the distance between the rolls on the top plate 2 and the rolls on the bottom plate 3. In this way it is simple to adjust the apparatus to a metal sheet with a different width.

[0029] The movement rolls 5a, 6a are adjustable in direction F, as shown in Fig. 3. In this way the movement rolls 5a, 6a can be placed out of line with the movement rolls 5, 6 and the pressure rolls 8, 10.

[0030] All pressure rolls 8, 9, 10 and movement rolls 5, 6; 5a, 6a are replaceable, for instance to curve a metal sheet with higher flanges 102.

[0031] The curving of a metal sheet 100 with the use of the apparatus or curving machine 1 will be elucidated hereinafter.

[0032] A straight longitudinal metal sheet 100 with flanges 102 and rims 103 is introduced into the bending machine 1 in direction D. The front end of the metal sheet is clamped between two pair movement rolls 5, 6, which rolls transport the sheet through the machine. The front end of the metal sheet 100 is thus introduced between the pressure rolls 8, 9 and 10 on both sides of the metal sheet 100. The front end of the metal sheet is transported further until it is clamped between the two pair movement rolls 5a, 6a. Then the pressure rolls 9, 10 are pressurised to press the flanges and rims of the metal sheet against the pressure rolls 8. The amount of pressure depends the kind of metal, the thickness of the metal sheet, the radius of the curvature that is required, and the transport velocity through the curving machine.

[0033] Due to the pressure on the flanges it is now possible to bend the flanged sheet, which is accomplished by the sideways adjustment of the movement rolls 5a, 6a. Subsequently the total length of the metal sheet that is to be curved is transported through the curving machine, during which treatment it is possible to adjust the movement rolls 5a, 6a so as to get a different radius of the curvature, when required.

[0034] It will be understood that the curving machine can be controlled in different ways. It is, for instance, possible to use hydraulic control for the rotation of the movement rolls and the pressure rolls and the adjustment of the movement rolls and the height of the adjustment bars. Alternatively it will be possible to control the curving machine electrically, or by a combination of hydraulic and electrical control.

[0035] It will be understood that the invention is not limited to the construction as described above and shown in the figures. For instance, it is possible to leave out the pressure rolls 10 when there are no rims 103 on the flanges 102. Also, instead of movement rolls it would be possible to use other transport means, such as linearly moving clamps that clamp on the flanges.

[0036] Moreover, it will be understood that the movement rolls 5, 6, 5a, 6a can be supported in different ways. Each movement roll can have its own supporting shaft ending in the top plate 2 or bottom plate 3. However, this has the disadvantage that each roll has to be driven , and that the top rolls 5, 5a must be synchronised with the bottom rolls 6, 6a. Therefore it is preferred that there are connecting shafts which connect each top roll with the accompanying bottom roll, in which way only the bottom rolls (or only the top rolls) have to be driven.. These connecting shafts have to be adjustable to follow the adjusting of the adjustable connecting bars 4, and the connecting shafts have to be dismountable to change the movement rolls when a metal sheet with

flanges with a different height or form must be curved.

[0037] Though the curving has been described above for a flanged metal sheet having a constant cross-section, it will be understood that the curving machine can also be used for a flanged metal sheet with a changing cross-section, that is a changing distance between the flanges over the length of the metal sheet, such as a tapered metal sheet. In this case, only one of the flanges is fed through the curving machine and clamped between the movement rolls and the pressure rolls, and the other flange is not clamped and pressurised. After the first flange has been curved in this way, the other flange is fed through the movement and pressure rolls and curved. Thus, the curving machine can be used to curve for instance a tapered sheet in two runs.

Claims

1. Method for curving a longitudinal metal sheet having a substantially flat portion with two opposite flanges along its sides, in which both flanges are pressurised at spots that are symmetrically situated opposite to each other, the pressure being successively exerted from the beginning to the end of the sheet to be curved, and in which the sheet is successively forced to bend in a section where the pressurised spots are present.

2. Apparatus for curving a longitudinal metal sheet having a substantially flat portion with two opposite flanges along its sides, the apparatus comprising pressure means for pressurising the flanges of the sheet at spots that are symmetrically situated opposite to each other, bending means at both sides of the pressure means, and transport means for moving the sheet relative to the apparatus.

3. Apparatus according to claim 2, in which the pressure means comprise pressure rolls that are provided at both sides of each flange.

4. Apparatus according to claim 2 or 3, for a sheet with flanges ending in outward-bent rims, in which the pressure means comprise a pressure roll at the outside of each flange, a pressure roll at the inside of each flange, and a pressure roll at the outside of each rim.

5. Apparatus according to any one of claims 2 - 4, the apparatus comprising a top sheet for the pressure rolls for one flange, a bottom plate for the pressure rolls for the other flange, and connecting bars between the top and bottom plate.

6. Apparatus according to claim 5, in which the connecting bars are adjustable.

7. Apparatus according to any one of claims 2 - 6, in which the transport means comprise movement rolls that fit over both longitudinal sides of the sheet, at both sides of the pressure means.

8. Apparatus according to claim 7, in which the movement rolls at one side of the pressure means are adjustable sideways to the transport direction of a sheet relative to the apparatus, in which these movement rolls can function as bending means during use.

9. Apparatus according to claim 7 or 8 in connection with claim 5 or 6, in which the movement rolls are rotatably connected to the top and bottom plate.

10. Apparatus according to any one of claims 2 - 9, the apparatus comprising control means for controlling the pressure of the pressure means, the transport velocity of the transport means, and the degree of bending of the bending means.

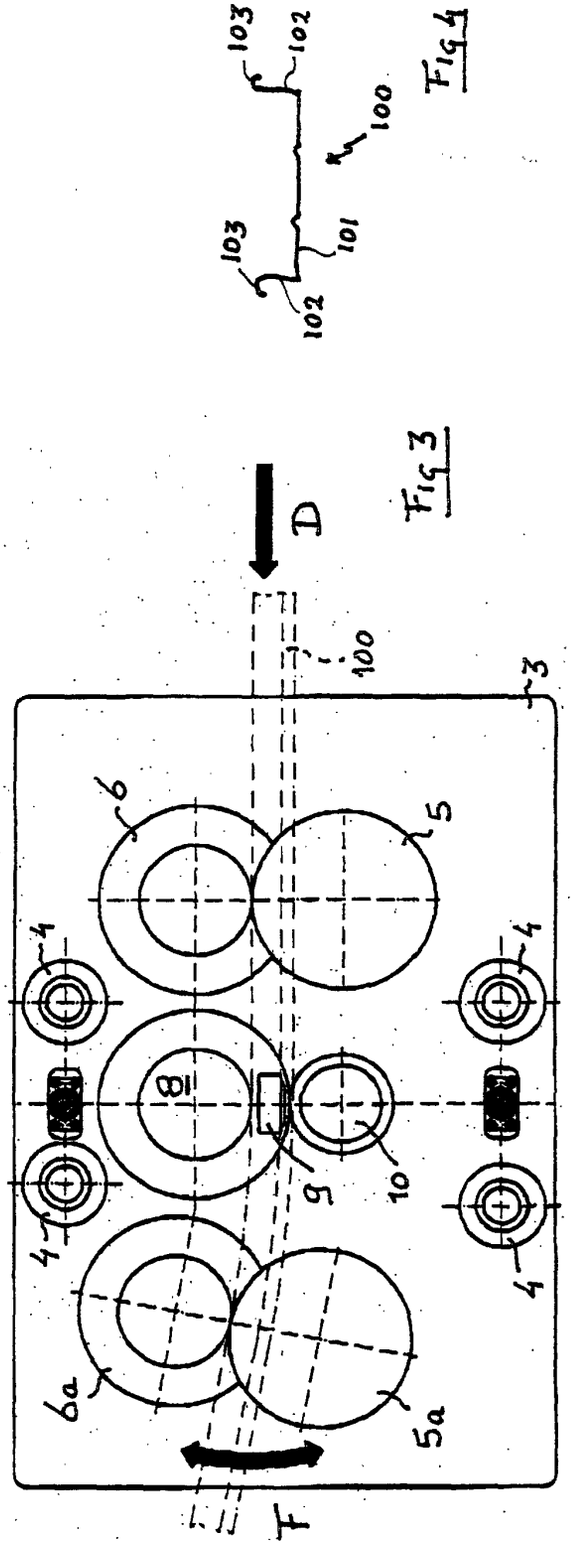

Fig 3

Fig 4

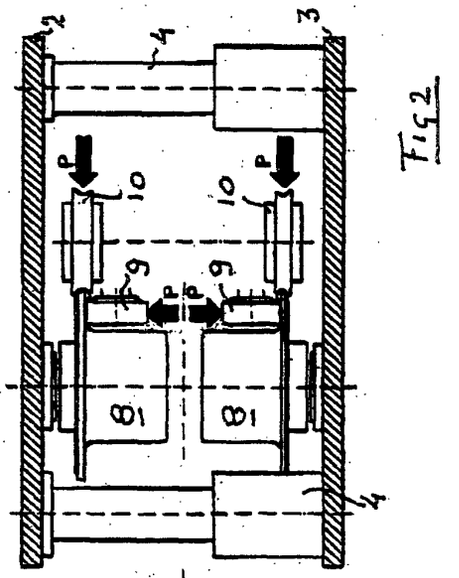

Fig 2

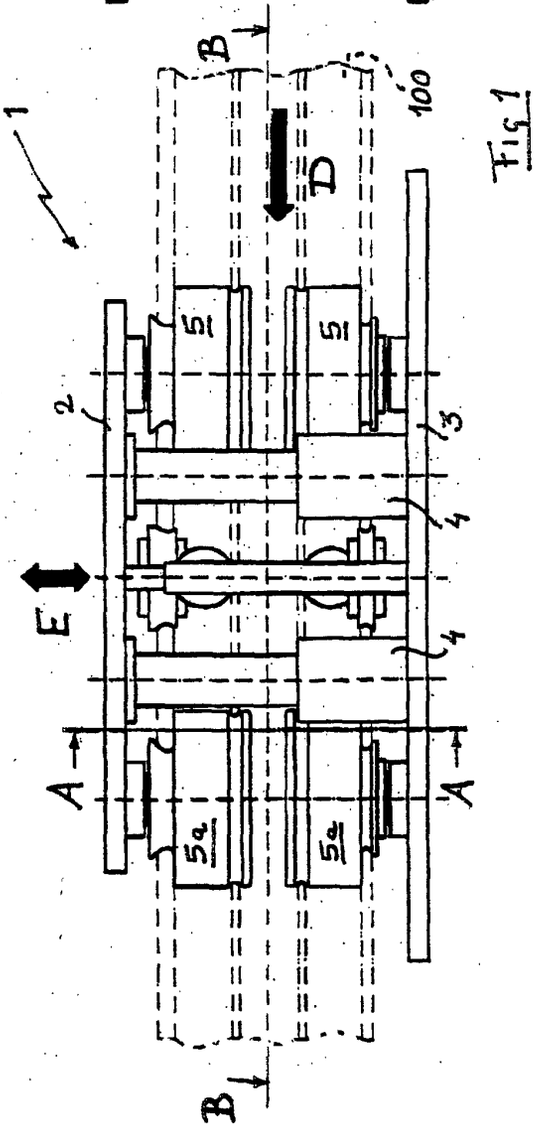

Fig 1

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EUROPEAN SEARCH REPORT

Application Number
EP 00 20 1162

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.7)
X Y	EP 0 296 317 A (SPÄTH GMBH & CO. KG) 28 December 1988 (1988-12-28) * claim 5 * * column 16, line 50 - column 17, line 9 * * figures 2-5,10A,13 * * column 17, line 48 - column 18, line 14 * ---	1-6,10 7-9	B21D7/08
Y	US 4 080 815 A (THE BOEING CO.) 28 March 1978 (1978-03-28) * figure 7 * -----	7-9	
			TECHNICAL FIELDS SEARCHED (Int.Cl.7) B21D

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
MUNICH	17 August 2000	Ash, R

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17-08-2000

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