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A method of and a press for bending of profiled sheet metal

This invention relates to a method of bending profiled sheet metal transversely with respect to the profile grooves of the sheet, according to which method

- a profiled sheet is positioned between two pressing elements displaceable with respect to each other,
- resilient filling pieces are positioned in the grooves of the profiled sheet in parallel with said grooves, and
- said pressing elements are pressed against each other in order to bend the profiled sheet and the filling pieces into a desired angle or arch around a transverse bending line.

Such a method is used for bending profiled sheet metal in a transverse direction to form angles and arches of different degrees.

Various rolling methods are previously known for bending of sheet metal having a relatively low profile for use in wall coverings and the like. The use of self-supporting sheets of deep profile forms, however, has recently become rather common in the building industry. Said rolling methods are no longer suitable for bending of such sheets, if the bent angle area of the sheet is to be made completely wrinklefree.

U.S. Patent Specification 2,944,583 discloses a device for bending of a profiled sheet, which device comprises an upper pressing element provided with a forming surface which has the same profile form as the sheet to be bent and which is curved to correspond to the arch angle to be bent. A bending table is positioned under the pressing element, which table supports a forming element provided with a forming surface which

has a straight profile form corresponding to the profiling of the sheet to be bent. In the bending situation, the forming element supported by the table is pressed against the upper pressing element through the sheet to be bent so that the profiles of said elements are intermeshed. The table can be turned over a desired angle with respect to the pressing element in such a manner that the forming element is continuously tangent to said pressing element.

Such a device enables a sheet to be bent to form an angle having a relatively large radius. Besides, bending of different kinds of profile forms always requires a new pressing element and a corresponding new forming element provided with the profiling in question. This is a laborious and extremely expensive operation.

U.S. Patent Specification 2,967,560 discloses a device for bending of profiled sheet metal, which device comprises two pressing elements to be pressed against each other. The forming surface of one of said elements is profiled to correspond to the profile form of the sheet to be bent, the forming surface of the other element being essentially smooth. During the bending of the sheet, each groove of the sheet on the side of the smooth-faced element is provided with a resilient filling bar, which during the bending operation is linearly pressed against the bottom and both sides of the groove by means of the smooth-faced element.

Such a device enables bending of a sheet into a sharper angle, but this way of bending is suitable for sheets having a relatively low profile form only, because the sides of deeper profile grooves are easily wrinkled because of insufficient support provided by said filling bars. Also in said device, bending of

different kinds of profile forms always requires replacing of the pressing element with a new one provided with the required profiling.

The object of this invention is to provide a method of bending which avoids the above-mentioned disadvantages and enables even bending of sheet metal having a deep profiling to be carried out so that the original form of the profile is maintained and the possible coating of the material to be bent is not damaged during the bending operation. This object is achieved by means of a method according to the invention, which is characterized in that

- each groove on each side of the profiled sheet is filled over the whole cross-section thereof with an incompressible bending core formed by at least two longitudinal, superposed strips longitudinally slidable with respect to each other, and

- that the profiled sheet is bent between forming surfaces formed by the pressing elements and extending smoothly in the direction of the bending line.

The invention is based on the idea that each groove on each side of the sheet is filled over the whole cross-section thereof by means of a bending core of a similar shape, which core consists of at least two superposed strips forming a filling piece of the same type as a leaf spring stack. This kind of bending core structure enables the filling piece to be manufactured of such a hard material that said core is completely incompressible and thus accurately keeps its shape, but, nevertheless, is sufficiently resilient to reliably follow the sheet to be bent. The mutual sliding movement of the strips of the core during the bending operation ensures that no essential longitudinal movement occurs between the core and the sheet, which might damage the coating of the sheet. Consequently,

the method enables a totally smooth and perfect angle to be bent into a sheet, regardless of the form and depth of the profile and even with a small bending radius.

With regard to bending of a thin profiled metal sheet into different kinds of angles, the radius of which must be made as small as possible regardless of the depth of the profile, which can be e.g. 50 mm, and regardless of the small material thickness, which can be 0.5-1.0 mm, the bending core is required to possess certain properties in order to achieve a faultless result.

In spite of the high compression strain exerted on the bending cores in connection with the bending operation, the cores must not change their shape and must possess the properties of steel. The strips of the bending cores can be made of e.g. steel or nylon.

The bending cores must bend in the longitudinal direction from a straight shape into an arched shape, when the bending operation proceeds. The required resilience is achieved by means of separate strips, which during the bending operation can slide in the longitudinal direction with respect to each other similarly to a leaf spring stack, and which after being released from compression, are straightened again.

In addition, the strips of the bending cores must have impact resistant and slippery surfaces so as to prevent formation of abrasion marks on the surface of the sheet to be bent. The cores must resist continuous bending strains, which is ensured by making the core of several strips. The number of strips is determined by the profile depth of the sheet to be bent and the desired bending radius. However, the bending core must not be too resilient, because a successful bending requires a sufficient counter friction in order

to achieve a required compression. A proper stiffness is also needed in order to ensure that no starting or ending marks difficult to be removed are left on the sheet to be bent.

The use of separate bending cores for each side of the sheet, which cores extend up to the height of adjacent ridges, enables the forming surfaces of the pressing elements to be made as completely smooth arched or planar surfaces so that when different kinds of profile forms are bent, only the bending cores must be replaced with other ones. This can be carried out easily and quickly. In this way, the same basic structure including the pressing elements can be used for different kinds of profile forms.

The invention is also concerned with a press for carrying out said method, which press comprises a press for bending of profiled sheet metal transversely with respect to the profile grooves of the sheet, which press comprises

- two pressing elements provided with forming surfaces facing each other, between which the sheet to be bent is positioned,
- means for displacing the pressing elements towards each other and for pressing said elements against the sheet from opposite sides, and
- longitudinal filling pieces to be fitted into the grooves of the sheet, said pieces pressing against the bottom of each groove and the forming surface of the respective pressing element.

The press according to the invention is characterized in that each filling piece is formed by at least two superposed strips longitudinally slidable with respect to each other, said strips forming a resilient core, the cross-section of which corresponds to that of said groove.

The invention will be described more closely in the following with reference to the attached drawings, wherein

Figure 1 is a front view of one preferred embodiment of a press according to the invention, when the pressing elements are in an open position,

Figure 2 illustrates the same as Figure 1, when the pressing elements are in a closed position,

Figures 3 and 4 are vertical sections of the press essentially along line A-A in Figure 1,

Figure 5 is a front view of a housing of the press and the pressing elements thereof as a partial vertical section,

Figure 6 is a top view of the housing,

Figure 7 is a section along line B-B in Figure 5,

Figure 8 is a perspective view of a profiled sheet bent by means of the press.

The press illustrated in the drawings comprises a frame 1 provided with a base 2 and two vertical columns 3, and an upper beam 4, which is vertically displaceable by means of pressure medium cylinders 5. Said upper beam is provided with a supporting plate 6 for an upper pressing element 7, which comprises a fastening beam 8. The opposite ends of the fastening beam are secured to said supporting plate 6 by means of vertically adjustable supports 9. The fastening beam is provided with pressing plates 10 forming a smooth arch-shaped forming surface 11.

A rectangular, box-like housing 12, the structure of which will be described in more detail below, is mounted on said base 2. The housing supports a lower pressing element 13 comprising two parallel halves. Each half is provided with a semicylindrical rail 14, which supports a pressing plate 15 forming a smooth planar forming surface 16. Each rail is supported

by two sliding plates 17 mounted in an L-shape in said housing. The rails are preferably made of steel, whereas the sliding plates are made of nylon.

An upper group of bending cores 18 and a lower group of bending cores 19 are positioned between the pressing elements. The opposite ends of the upper cores are fastened on flat rails 20, which, in turn, are suspended from the supporting plate 6 of the upper pressing element by means of spring supports 21 in such a manner that the cores are horizontally positioned and tangent to the forming surface 11. The ends of the lower cores are similarly fastened on flat rails 22, which, in turn, are mounted on the base by means of spring supports 23 so that the cores are horizontally positioned on the pressing plates 15 of the lower pressing element.

Each core comprises three longitudinal nylon strips 24, which are superposed similarly to a leaf spring stack. The cross-section of the core corresponds to that of each groove in the profiled sheet to be bent from the bottom of the groove up to the level of the adjacent ridges. The cores of each group are fastened at a distance from each other, said distance corresponding to the spacing of the grooves in the sheet to be bent. The cores of the upper and the lower group are positioned so as to intermesh with each other, as illustrated in Figure 1.

The bending of a profiled sheet is carried out as follows:

When bending a profiled sheet metal 25 according to the shape shown in Figure 8, which sheet metal forms alternating grooves 26 and ridges 27, the sheet is displaced in a horizontal position between the two groups of cores and is positioned on the lower group of cores so that the cores 19 fit into the lower grooves

of the sheet. When the upper pressing element is descended, the cores 18 of the upper group of cores are inserted into the upper grooves of the sheet so that the bottoms and sides of all grooves of the sheet, which is positioned between the two groups of cores, are tightly pressed against the respective surfaces of the cores, and the forming surfaces of the pressing elements are pressed against the ridges and the outer surfaces of the cores.

When the upper pressing element is hydraulically pressed downwards between both rails of the lower pressing element, the rails turn around their axes against the L-shaped sliding plates 17, as illustrated in Figure 4. The arched forming surface 11 of the upper pressing element and the planar pressing plates 15 of the lower pressing element are pressed against the ridges of the sheet to be bent and the cores so that the sheet is bent into an arch determined by the forming surface 11.

At the beginning of the bending operation, wrinkles are formed in that portion of the sheet which is adjacent the angle arch, which wrinkles, however, cannot grow excessively by virtue of the increasing pressure of the cores. As the bending proceeds, the strips of the cores start to bend and simultaneously slide against each other. The pressing step takes place at the end of the bending operation, whereby, by virtue of the wedge-like shape of the cores, the pressure exerted on all surfaces of the cores is increased to such an extent that the wrinkles and irregularities possibly formed on the bending surface of the sheet at the beginning of the bending disappear and the upper surface and the vertical parts of the profile are compressed and the outer arch of the profile is correspondingly stretched.

When deep profile shapes are bent, it is advisable to perform several pressing steps simultaneously as the sheet to be bent is displaced over a required distance prior to the next pressing step, until a desired arching is achieved.

After the bending operation is completed, the upper pressing element is lifted to its upper position, whereby the bent sheet can be drawn out from between the bending cores and the cores bend back to a horizontal position.

As illustrated in Figures 5-7, the housing 12 comprises two halves 28, 29 which intermesh with each other in a comb-like manner, said halves being connected with each other by means of adjusting screws 30 so that the housing can be widened or narrowed as required. This kind of adjusting is necessary, when the profile of the sheet is changed so a deeper or lower profile and the pressing points, consequently, require the pressing plates 15 to be displaced in order to achieve the best bending result.

The opposite ends of each rail 14 of the lower pressing element are provided with stationary stops 31. A moving stop 32 is fastened at the end of the pressing plate 15 of the rail and a wedge 33 is fitted between said stop and the stationary stop positioned on the same side. The wedge is fastened on the rail by means of an adjusting bolt 34. By tightening said adjusting bolt, the moving stop can be displaced so that the group of cores 19, which is positioned between the moving stop and the stationary stop at the opposite end of the rail, is adjustable to desired tightness. By virtue of the tightness of the cores, the material to be bent can be pressed so tightly between the wedge-like vertical surfaces of the cores that the small wrinkles and irregularities formed in the initial

stage of the bending are straightened.

The pressing plates 10 of the upper pressing element are fastened on the fastening beam 7 by means of bolts so that the plates can be easily replaced with pressing plates of a desired arching. The pressing element can also be turned to one side thereof by means of the supports 8.

In order to enable a longitudinal movement of the core strips with respect to each other, the ends thereof are provided with elongated holes. The strips are fastened on the flat rails 20 and 21 respectively by means of bolts extending through said holes. In order to prevent a transverse movement of the strips with respect to each other, said strips are interconnected in a suitable manner, e.g. by means of a longitudinal groove and ridge joint. A profile having a depth of e.g. 50 mm generally requires five nylon strips of a thickness of 10 mm.

The drawings and the description related thereto are only intended to illustrate the idea of the invention. In its details, the method and the press according to the invention may vary within the scope of the claims.

In some cases, e.g. when bending profiled sheets having a depth less than 20 mm, a rubber cushion having a hardness of approx. 60-80. Shores can be used as a lower pressing element in place of both rails 14. The lower group of bending cores is in that case positioned directly on the rubber cushion, whereby the rubber works in very much the same way as the rails. The bending operation can also be carried out obliquely by positioning the bending cores in an oblique position with respect to the axis of the arched forming surface of the upper pressing element.



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Claims:

1. A method of bending profiled sheet metal transversely with respect to the profile grooves of the sheet, according to which method

- a profiled sheet (25) is positioned between two pressing elements (7, 13) displaceable with respect to each other,

- resilient filling pieces (18, 19) are positioned in the grooves (26) of the profiled sheet in parallel with said grooves, and

- said pressing elements are pressed against each other in order to bend the profiled sheet and the filling pieces into a desired angle or arch around a transverse bending line, c h a r a c t e r i z e d in that

- each groove (26) on each side of the profiled sheet is filled over the whole cross-section thereof with an incompressible bending core (18, 19) formed by at least two longitudinal, superposed strips (24) longitudinally slidable with respect to each other, and

- that the profiled sheet is bent between forming surfaces (11, 16) formed by the pressing elements (7, 13) and extending smoothly in the direction of the bending line.

2. A press for bending of profiled sheet metal transversely with respect to the profile grooves of the sheet, which press comprises

- two pressing elements (7, 13) provided with forming surfaces (11, 16) facing each other, between which the sheet (25) to be bent is positioned,

- means (5) for displacing the pressing elements towards each other and for pressing said elements against the sheet from opposite side, and

- longitudinal filling pieces (18, 19) to be



fitted into the grooves (26) of the sheet, said pieces pressing against the bottom of each groove and the forming surface of the respective pressing element, characterized in that each filling piece (18, 19) is formed by at least two superposed strips (24) longitudinally slidable with respect to each other, said strips forming a resilient core, the cross-section of which corresponds to that of said groove (26).

3. A press according to Claim 2, characterized in that the forming surfaces (11, 16) of the pressing elements (7, 13) are continuously smooth-faced in the direction of the bending line.

4. A press according to Claim 3, characterized in that one pressing element (7) forms an arched forming surface (11) in parallel with the bending line.

5. A press according to Claim 2 or 3, characterized in that one pressing element (13) is formed by two separate pressing halves parallel with the bending line, each half comprising a semi-cylindrical rail (14) and a planar pressing plate (15) supported thereby.

6. A press according to Claim 5, characterized in that said pressing halves are supported by a housing (12) provided with an L-shaped base formed by sliding plates (17) for each pressing half, and that said housing is provided with means (30) for displacing said bases with respect to each other.

7. A press according to Claim 5, characterized in that each pressing half of said one pressing element (13) extends transversely outside the cores (18, 19) formed by the strips (24), the ends of each half being provided with stops (31, 32)



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between which the cores are positioned, and that each pressing half is provided with means (33,34) for displacing said stops with respect to each other.

5        8. A press according to any of Claims 2-7, characterized in that the ends of the cores (18,19) formed by said resilient strips (24) are fastened to the respective pressing element (7,13) by means of spring supports (21,23).

10       9. A press according to any of Claims 2-8, characterized in that the strips (24) of the cores (18,19) are made of nylon.

15       10. A press according to any of Claims 2-9, characterized in that the strips (24) of each core (18,19) are provided with longitudinal grooves in engagement with each other, said grooves preventing a transverse displacement of the strips with respect to each other.

20       11. A press for bending sheet metal and substantially as hereinbefore described and as shown in Figure 1 to 7 of the accompanying drawings.

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