This invention relates to apparatus for bending a web of plant material and more particularly for simultaneously making double angularly disposed bends in a length of sheet or web of plant material.

In the past it has been necessary, by known methods and apparatus, to severally introduce bends into a web of plant material. Such methods and apparatus had the inherent disadvantage of increased labor costs.

One of the common bending problems in the past has been the fact that introducing angular bends severally in a long strip of metal required large areas of free space to position the bending section of the strip to swing accurately while being bent. Depending upon the necessary length of the metal strip, this was often very costly in wasted space and a very awkward and dangerous manner for bending metal. Therefore, one object of our invention is to provide method and apparatus greatly minimizing the necessary space for introducing a plurality of bends into a given length of metal strip.

It is a significant object of our invention to provide apparatus for simultaneously introducing oppositely disposed bends in a web of plant material.

Another object of our invention is to provide apparatus for simultaneously introducing bends having bending axes forming oblique angles with the edge of the plant web material.

It is an important object of our invention to provide apparatus for appreciably reducing the cost of introducing a plurality of bends into a web of material.

Other objects and advantages of this invention will be particularly set forth in the claims and will be apparent from the following description, when taken in connection with the accompanying drawings, in which:

FIG. 1 is a front elevational view of one embodiment of our invention;
FIG. 2 is a back elevational view of the embodiment illustrated in FIG. 1;
FIG. 3 is a top planar view of the FIG. 1 embodiment of our invention partly in section for purposes of illustration;
FIG. 4 is a top planar view of the FIG. 1 embodiment of our invention with parts moved to a second position distinguishable from that of FIG. 3; and
FIG. 5 is a sectional view taken along the line 5—5 of FIG. 1 looking in the direction indicated by the arrows.

With reference to the drawings, our invention generally comprises three sections, end-bending section 16, intermediate-bending section 12 and another end-bending section 22.

Intermediate-bending section 12 is a vise including a front plate 22, hinged at 23 to end section 16, and a back plate 24, hinged at 26 to end-bending section 16. Plates 22 and 24 are hinged together at their lower ends by a hinge 25. A compression spring 27 is provided between plates 22 and 24 for yieldingly biasing the plates apart. Hinges 23 and 26, constitute bending axes and are so referred to hereinafter. Plates 22 and 24 are tied together by a bolt 28 traversing both plates and threaded into a block 30 (FIGS. 4 and 5). Block 30 carries a lever 32 pivotally mounted thereon by a pin 34 traversing holes in both arms of a yoke 36 of lever 32 and a registering hole in block 30. Yoke 36 has an arcuate cam surface, illustrated in FIG. 5, for opposing spring 27 to bring plates 22 and 24 into engaging relationship when lever 32 is actuated in a clockwise direction away from the position shown in FIG. 5 by the application of force to a handle 38 threaded onto the upper end of lever 32.

For purposes of illustration, we have shown our invention being used with a length of sheet or web material 40. It will be understood that our invention is adapted for use with round bar stock or other material of a plant nature.

Web material 40 is aligned in a horizontal position by the operator, between a plurality of adjustable guides 42, 44 and 46. Guide 42 is adjustably mounted, for example, by bolts 43 to end-bending section 10 for engaging the lower edge of web material 40. Guide 44 is adjustably mounted to bending section 14, as for example by bolts 45 (FIG. 2) for engaging the upper edge of the web material 40. Guide 46 is of a C-shaped cross section and adjustably mounted, as for example, by bolt 47 to section 14. C-shaped guide 46 has a lower surface 48 adapted for supporting the lower edge of web material 40. It will be understood that this arrangement of guides maintains the web material 40 in proper horizontal alignment, while the operator applies force to lever 32 in order to frictionally engage both faces of the web material 40 between the vice provided by plates 22 and 24. It will also be understood that the adjustment of the three guides permitted by bolts 43, 45 and 47 renders this embodiment adaptable for use with a variety of widths of web material 40.

There is a tension spring 50, intermediate back plate 24 and a wall or other vertical supporting surface 52, yieldingly biasing intermediate-bending section 12 to the vertical position illustrated in FIGS. 1, 2 and 3 and permitting pivotal movement of intermediate-bending section 12 about hinges 26 as illustrated in FIG. 4.

This embodiment of our invention includes an adjustable linkage, generally indicated by the numeral 54 (FIG. 2), for maintaining a pre-selected planar relationship between end-bending section 10 and end-bending section 14 while intermediate bending section 12 is moved between the positions illustrated in FIGS. 3 and 4. The adjustable linkage 54 includes interconnecting sections 12 and 14 includes projections 56 and 58 rigidly mounted respectively on end-bending section 10 and end-bending section 14. Projections 56 and 58 pivotally carry, at 57 and 59 respectively, thread locks 60 and 61. A turn buckle 62 adjustably interconnects links 60 and 61.

This arrangement provides means for selectively adjusting the angular relationship between the projections 56 and 58 and end-bending sections 10 and 14. Whatever the angular relation of sections 10 and 14, as per the adjustment of the turn buckle 62, such angular relationship will be maintained by this linkage as the intermediate section 12 is pivoted from the position shown in FIG. 3 to the position of FIG. 4. Ordinarily, the turn buckle 62 is adjusted to maintain sections 10 and 14 in parallel relationship, thereby providing the same bending angle along the two bending axes provided along the edges of intermediate section 12 and both pairs of hinges 23 and 26.

A particularly unique feature of the illustrated embodiment of our invention is to provide oppositely disposed bends extending along bending axes 23 and 26, which bending axes make oblique angles with the edges of the web material 40. Thus we have provided novel method and apparatus for making flue gas turbulators of the nature described in the Walter B. Brock Patent No. 2,591,398, issued April 1, 1952.
The bending angle provided along the bending axes 23 and 26 may be selected by an adjustable-threaded-stop member 68 (FIG. 1) carried by a support member 70 rigidly mounted to end-section 10. In the alternative, this adjustment might be provided by a bolt, in lieu of screw 68, for use with shims between the bolt and support member 70. The head of screw 68 engages front plate 22 to limit the downward pivotal movement of the vice or intermediate-bending section 12 about the hinges 26.

There is a tension spring 67 (FIGS. 3 and 4) connected at one end to projection 58 and at the other end to a wall or other rigid supporting surface 52A thereby yieldingly biasing end-section 14 toward an aligned position, in which the three bending sections 10, 12 and 14 are in alignment as viewed in FIGS. 1-3.

In operation, the web material 40 is inserted in the above described apparatus and placed in proper alignment between guides 42, 44 and 46 in the position illustrated in FIGS. 1-3. Then, the operator applies clockwise force, as viewed in FIG. 5, to the handle 38 of lever 32, thereby camming front plate 22 and back plate 24 into frictional gripping relationship with both faces of web material 40. This force is referred to in the claims as "bending force." Thus, the web material is supported in substantially rigid relationship. The operator then continues to apply clockwise force on the handle 38, in opposition to tension springs 50 and 67, to pivot intermediate section 12 about hinges and bending axes 23 and 26 until the front plate 22 abuts threaded stop-member 68 at the position illustrated in FIG. 4.

In this manner, the desired oppositely disposed angular bends are introduced into the web material. Thereafter, the operator releases the handle 38 permitting the tension springs 50 and 67 to return intermediate-section 12 and end-section 14 to the aligned position illustrated in FIGS. 1 and 3. When lever 32 is released, the arcuate cam surface of yoke 36 permits spring 27 to return lever 32 to the position of FIG. 1, and front plate 22 and back plate 24 release the web material 40.

When the above described apparatus is returned to the aligned position of FIG. 3, the web material assumes the position shown in broken line at 40A (FIG. 3). As illustrated, 40A is of a C cross-sectional configuration. This selected configuration prevents the right end, as shown at 40A in FIG. 3, from falling off of the guide 46 and out of alignment when the apparatus is returned to the position of FIG. 3. This configuration also limits the arcuate movement of the free ends of the material 40A as it is returned to this position. It will be noted that the guides 42 and 44 are positioned as close to the vice or intermediate section 12 as will be permitted without interfering with the bending operation of our apparatus, in order to help prevent the web material 40A from slipping off of these guides after the lever 32 is released and the apparatus is returned to the FIG. 3 position. After the apparatus has been returned to the aligned position of FIGS. 1 and 3, the operator simply removes the web material 40A.

If additional multiple bends are desired, the operator snugly fits the bend produced along axis 23 around the nose or section 72 of section 19 while aligning the tail stock of the web material 40A between guides 42, 44 and 46. It will be understood that the selected spacing between oppositely disposed angles may be provided by selecting the width of bending sections 10 and 12 measured in a horizontal plane.

Because of the double bend, whereby the free ends of the material 40 (FIG. 4) are formed in parallel relationship, it is possible, by positioning guide 44 further to the right as viewed in FIG. 4, to enable the operator to release lever 32, while maintaining the apparatus in the FIG. 4 position, and to move the material 40A from the apparatus with only very slight arcuate movement of the right end thereof sufficient to by-pass guide 44.

In the illustrated embodiment, only one face of the web material 40 bears against end plates or end bending sections 10 and 14, thereby simplifying operation of the material being bent along the faces of sections 10 and 14 as the vice or intermediate section 12 is actuated by the operator to the position shown in FIG. 4. It will be understood that our invention is adapted for many modifications in this regard. For example, the end-bending sections 10 and 14 could be made vises, in lieu of intermediate section 12 or all sections could be vises.

While we have shown and described the preferred form of mechanism of this invention it will be apparent that various modifications and changes other than those suggested above may be made therein, particularly in the form and relation of parts, without departing from the spirit of this invention as set forth in the appended claims.

We claim:

1. Bending apparatus comprising, in combination: three bending sections pivotally mounted together at two bending axes including an intermediate section and two end sections, means for rigidly mounting a first of said end sections to a support member; means supporting a length of plant material in a substantially rigid position with respect to at least one of said sections; means responsive to bending force being applied to said intermediate section for pivoting said inner of said sections about said axes; means interconnecting said end sections for maintaining a preselected planar relationship between said end sections during bending of said length of material; and yielding means biasing said intermediate and second end section toward a position in which all three sections are biased toward a straight line relationship.

2. Bending apparatus comprising, in combination: clamping means supporting a length of plant material in a substantially rigid position; aligning means comprise with said clamping means for confining a length of said material having substantially parallel extending edges in a position for imparting the hereinafter claimed angles in said length of material, first bending means operative with said clamping means and aligning means for bending said length of material along a first axis making an oblique angle with the edges of said material as supported in said position, and second bending means operative with said first bending means for substantially simultaneously bending said length of material along a second bending axis making an oblique angle with the edges of said length of material and spaced from said first axis.

3. Bending apparatus comprising, in combination: three bending sections pivotally mounted together at two bending axes including an intermediate section and two end sections, means for rigidly mounting one of said sections to a support member, means supporting a length of plant material in a substantially rigid position with respect to at least one of said sections, means interconnecting said end sections for maintaining a preselected planar relationship between said end sections during bending of said length of material, including adjustment means for said interconnecting means for varying the planar relationship between said end sections, and means for simultaneously varying both of the preselected bending angles imparted to said length of plant material at said bending axes thereby to maintain both of said bending angles in the preselected relationship.

4. Bending apparatus comprising, in combination, vice means adapted for frictionally engaging both faces of a portion of a length of plant material spaced intermediate the ends of the material, first bending means connected to a first edge of said vice means for bending said length at said first edge, second bending means connected to a second edge of said vice means for bending said length at said second edge and a bending force applied at said vice means and operative with said first and second bending means for substantially simultaneously bending said length at both of said edges.
5. Apparatus in accordance with claim 4 including adjustment means limiting to a pre-selected amount the bending angle which said vice means makes to the bending sections.

6. Bending apparatus comprising, in combination, vice means including a pair of clamp members adapted for frictionally engaging and supporting both faces of a length of plant material in a normal position, a first bending plate hinged for pivotal movement at a first edge of said vice means to one of said clamp members, a second bending plate hinged for pivotal movement at a second edge of said vice means to one of said clamp members, means for rigidly mounting one of said bending plates to a support member, both of said bending plates being coactive with said vice means and responsive to bending force applied at said vice means and to pivotal movement at said edges to bend said plant material along said two edges thereof.

7. Bending apparatus comprising, in combination, three bending sections pivotally mounted together at two bending axes including an intermediate section and two end sections, means for rigidly mounting a first of said end sections to a support member, means supporting a length of plant material in a substantially rigid position with respect to at least one of said sections, means responsive to bending force being applied to said intermediate section for pivoting said intermediate and a second of said sections about said axes.

8. Bending apparatus comprising, in combination, vice means including a pair of clamp members adapted for frictionally engaging and supporting both faces of a length of plant material in a normal position, a first bending plate hinged for pivotal movement at a first edge of said vice means to one of said clamp members, a second bending plate hinged for pivotal movement at a second edge of said vice means to one of said clamp members, both of said bending plates being cooperative with said vice means, responsive to pivotal movement at said edges to bend said plant material along the two edges thereof and means responsive to bending force being applied to said vice means for substantially simultaneous pivotal movement at both of said edges.

9. Apparatus in accordance with claim 8 in which said last mentioned means includes a handle having a cam for compressing said vice means, to which handle force is imparted for pivotal movement at both of said edges.

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