Jan. 10, 1939. A. R. KELSO 2,143,443

BENDING MACHINE

Filed Nov. 8, 1937 2 Sheets-Sheet 1

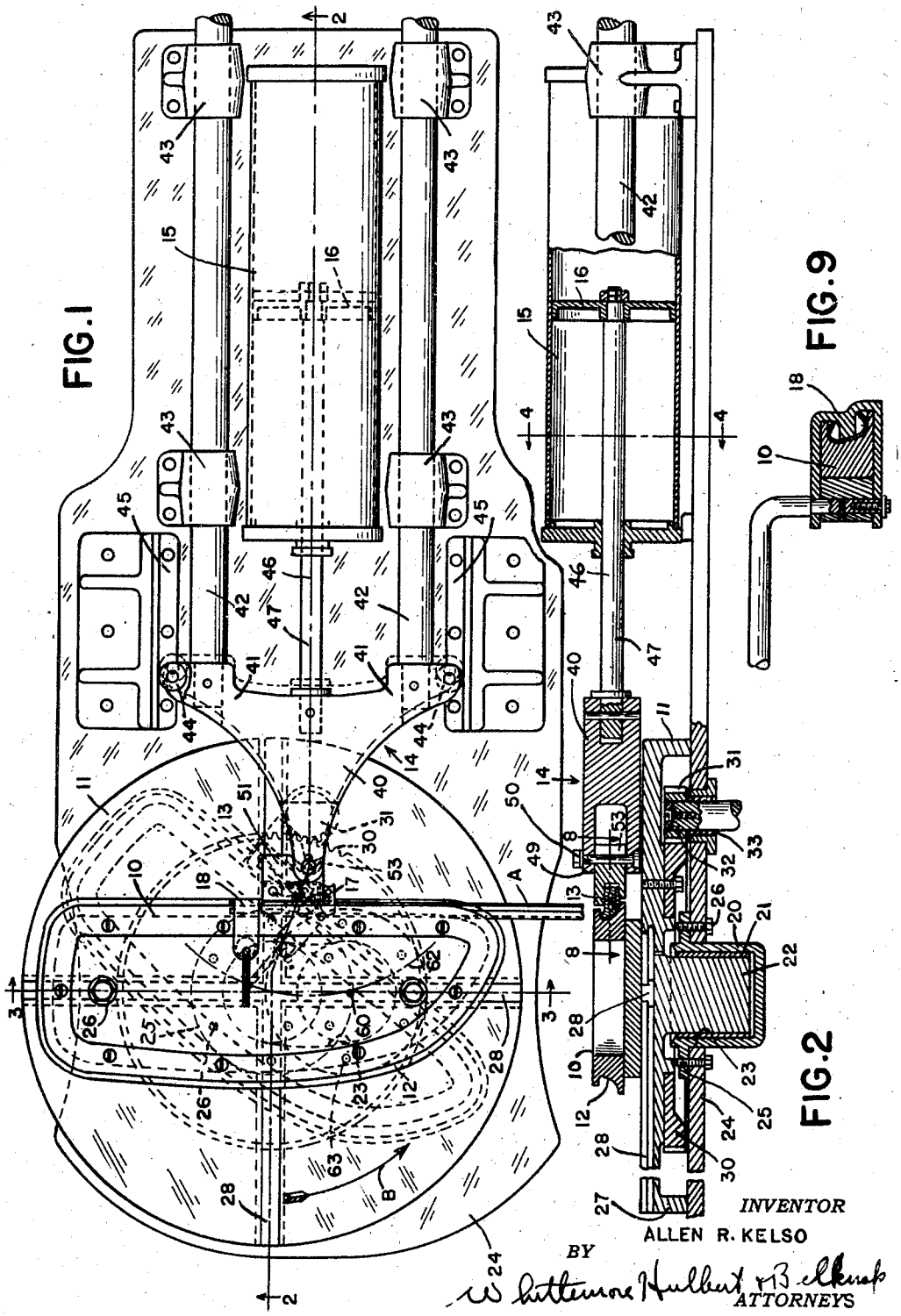

FIG. 1



FIG. 9



FIG. 2

INVENTOR
ALLEN R. KELSO

BY
Whittemore Hulbert & Belknap
ATTORNEYS

Jan. 10, 1939. A. R. KELSO 2,143,443

BENDING MACHINE

Filed Nov. 8, 1937 2 Sheets-Sheet 2

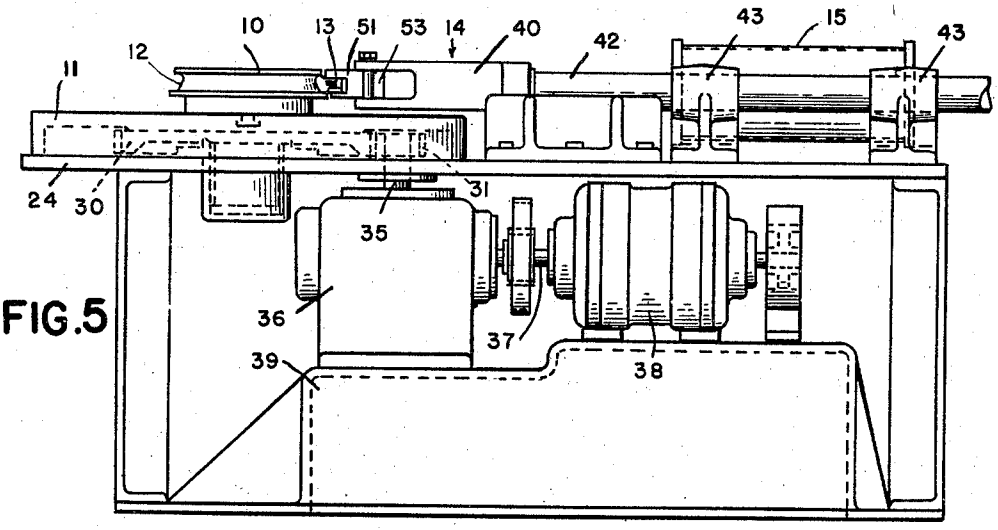


FIG.5

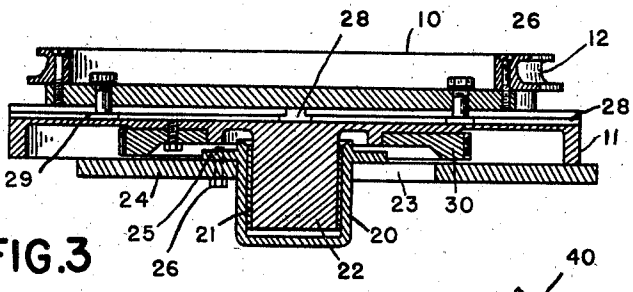


FIG.3

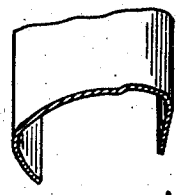

FIG.7

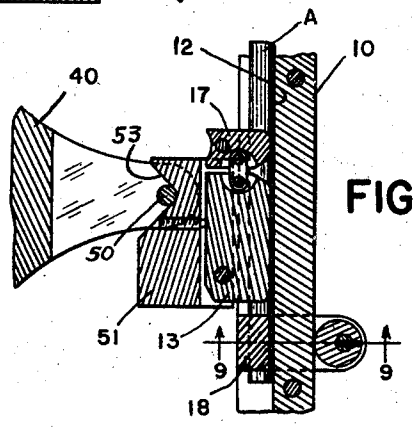


FIG.8

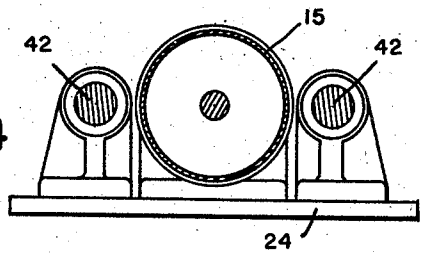


FIG.4

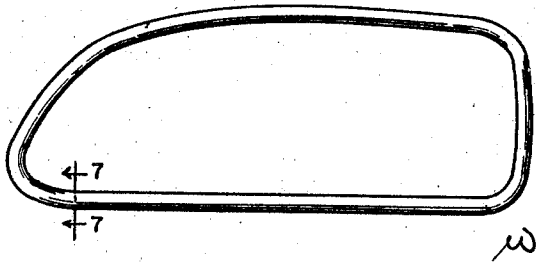


FIG.6

INVENTOR
ALLEN R. KELSO

BY
Whittemore Hulbert & Belknap
ATTORNEYS

Patented Jan. 10, 1939

2,143,443

# UNITED STATES PATENT OFFICE

2,143,443

## BENDING MACHINE

Allen R. Kelso, Detroit, Mich., assignor to Motor Products Corporation, Detroit, Mich., a corporation of New York

Application November 8, 1937, Serial No. 173,520

9 Claims. (Cl. 153—40)

This invention relates generally to bending machines and refers more particularly to machines for bending strip stock to a predetermined longitudinal contour.

It is one of the principal objects of this invention to increase the production of longitudinally contoured strips by providing a machine equipped with means rendering it possible to rapidly and accurately bend the strips to the desired longitudinal contour without overstressing or wrinkling the stock during the bending operation.

A further feature of this invention resides in the provision of a machine capable of bending a straight strip of stock having a prefashioned cross sectional contour to form a closed frame of predetermined longitudinal contour without deforming or interfering in any way with the cross sectional contour of the strip during the bending operation.

The foregoing, as well as other objects, will be made more apparent as this description proceeds, especially when considered in connection with the accompanying drawings, wherein:—

Figure 1 is a plan view of a bending machine constructed in accordance with this invention;

Figure 2 is a longitudinal sectional view taken substantially on the plane indicated by the line 2—2 of Figure 1;

Figure 3 is a cross sectional view taken substantially on the plane indicated by the line 3—3 of Figure 1;

Figure 4 is a cross sectional view taken substantially on the plane indicated by the line 4—4 of Figure 2;

Figure 5 is a side elevational view of the bending machine;

Figure 6 is a side elevational view of a garnish molding frame formed from a straight strip of stock by the machine forming the subject matter of this invention;

Figure 7 is a cross sectional view taken substantially on the plane indicated by the line 7—7 of Figure 6;

Figure 8 is a sectional view taken substantially on the line 8—8 of Figure 2; and

Figure 9 is a sectional view taken substantially on the plane indicated by the line 9—9 of Figure 8.

The machine selected herein for the purpose of illustrating the present invention is particularly designed to form garnish molding frames from a straight strip of stock having the desired cross sectional contour, although it will be understood as this description proceeds that the principles involved in my machine may be advantageously employed to bend strip stock to various different longitudinal contours.

In general, a templet frame 10, corresponding in shape to the longitudinal contour of the garnish molding frame it is desired to produce, is adjustably secured to the top of a rotatable table 11, and a shoe 13 is positioned opposite the perimeter of the templet frame 10 to cooperate with the latter in bending a substantially straight strip of stock around the templet frame. Upon reference to Figure 2, it will be noted that a continuous recess 12 is formed in the perimeter of the templet frame 10, and that this recess is fashioned to have a cross sectional contour predetermined to cooperate with the shoe 13 to effectively engage the strip A to be bent throughout the cross sectional area of the strip.

The sides of the templet frame 10 are non-symmetrically disposed with respect to the axis of rotation of the table 11 and, in order to permit the shoe 13 to move toward and away from this axis in accordance with variations in the longitudinal contour of the frame, the shoe is engaged with a reciprocable slide 14. The slide 14 is normally urged toward the templet frame by compressible means characterized in that it exerts sufficient pressure on the strip of stock to effectively bend the strip around the templet frame and, at the same time, allows displacement of the shoe relative to the axis of rotation of the table during rotation of the non-symmetrical templet frame relative to the shoe. For the purpose of illustrating the invention, I have shown the compressible means as being in the form of an air cylinder 15 having a piston 16 reciprocably mounted therein and operatively connected to the slide 14.

In order to insure properly bending the strip of stock around the angularly spaced portions of the templet frame 10, the shoe 13 is fulcrumed on the inner end of the slide 14 for limited swinging movement in the plane of the templet frame. It should also be noted that the shoe 13 is articulated in that it is provided with an end section 17 pivotally connected to the body portion of the shoe in such a manner as to permit the end section to swing in the plane of the templet frame relative to the remaining portion of the shoe. As shown in Figure 1, the pivotally connected section 17 of the shoe extends in a direction opposite the direction of rotation of the table 11 from the point of fulcrum of the shoe 13 on the inner end of the slide. As a result, the strip is effectively supported throughout its cross sectional area during the interval

the strip is bent around the angularly extending portions of the templet frame. Attention is further directed to the fact at this time that the shoe merely has a bearing engagement with the inner end of the slide 14 and, as a consequence, may be readily assembled with, or removed from the slide. This construction is of particular importance in cases where the cross sectional contour of the strip of stock A is such as to necessitate telescoping the shoe within the stock, since in instances of this character, it is more expedient to assemble the shoe with the straight strip of stock prior to introducing the stock into the machine.

In the present instance, a strip of stock having the desired cross sectional contour and having a length sufficient to form a closed garnish molding frame is assembled with the shoe by telescoping the latter in one end portion of the stock. The shoe is then assembled on the inner end of the slide 14 and the free end of the stock adjacent the shoe is secured to the templet frame by means of a clamp 18. The parts are shown in this position by the full lines in Figure 1, and it will be noted from this figure that the clamp 18 is carried by one of the straight sides of the templet frame. After the strip of stock is secured to the templet frame, the table 11 is rotated in the direction of the arrow B in Figure 1, and the strip of stock is bent around the perimeter of the templet frame 10 by the shoe 13. It will, of course, be understood that before rotation of the table 11 is effected, air under pressure is supplied to the air cylinder 15 at the outer side of the piston 16 so that the shoe is yieldably clamped against the strip of stock during the bending operation.

Upon completion of the bending operation, rotation of the table is automatically discontinued by suitable means (not shown), and the piston 16 in the air cylinder 15 is moved outwardly to release the clamping pressure exerted on the strip of stock by the shoe 13. This is effected by exhausting the fluid pressure in the cylinder 15 at the outer side of the piston and admitting fluid pressure into the cylinder at the inner side of the piston. The bent strip, with the shoe 13 in assembled relation therewith, is removed from the machine, and the shoe 13 is slipped off one end of the strip. Upon completion of this latter operation, the table is advanced to its starting position, shown by the full lines in Figure 1, and another straight strip of stock is assembled in the machine.

Referring now more in detail to the particular construction of the machine, it will be noted from Figure 2 that the table 11 is provided with a centrally disposed downwardly extending cylindrical portion 20 and that the latter is journalled in a bearing 21 supported in a hub 22. The hub 22 extends through an opening 23 formed in a supporting plate 24 and is provided with a radially outwardly extending flange 25 which is clamped to the top surface of the plate 24 by means of the fastener elements 26.

The table 11 is supported in spaced relation to the plate 24 above the latter by means of an annular flange 27 concentrically arranged with respect to the axis of rotation of the table and having a bearing engagement with the plate 24. The top of the table is formed with transversely extending grooves 28 which intersect at the axis of rotation of the table and cooperate with suitable keys 29 on the underside of the templet frame 10 to rotate the latter as a unit with the table. The table is rotated, in the present instance, by means of a ring gear 30 secured to the underside of the table in concentric relation to the axis of rotation of the latter and adapted to mesh with a pinion 31 secured to the upper end of a power take-off shaft 32. The power take-off shaft 32 is journalled in a bearing 33 secured to the plate 24 and is operatively connected to the driven shaft 35 of a speed reducer 36 through the medium of reduction gearing (not shown). The driven shaft 35 is operatively connected to the drive shaft 37 of an electric motor 38. Both the electric motor 38 and the speed reducer 36 are secured to a support 39 forming a part of the machine frame.

It has previously been stated that the compressible means 15 acts upon the slide 14 to permit movement of the shoe toward and away from the axis of rotation of the table in dependence upon the longitudinal contour of the templet frame 10 to insure effectively clamping the strip of stock against the frame 10 throughout rotation of the latter. In detail, the slide 14 comprises a bracket 40 having laterally outwardly projecting extensions 41 at the outer end thereof secured to the inner ends of longitudinally extending rods 42 which are slidably supported at longitudinally spaced points in bearings 43 secured to the plate 24. The bracket 40 is guided throughout its movement toward and away from the axis of rotation of the table 11 by means of rollers 44 secured to the lateral extensions 41 and adapted to engage suitable tracks 45 which are also secured to the plate 24 of the machine. It will be noted from the above that the bracket 40 is not only adequately supported on the plate 24 for sliding movement toward and away from the axis of rotation of the templet frame 10, but is also accurately guided throughout its sliding movement.

The compressible means 15 for normally urging the bracket in a direction toward the templet frame 10 to effectively clamp the shoe 13 against the strip being bent, comprises a cylinder rigidly secured to the plate 24 between the rods 42 with the axis 46 extending at right angles to the axis of rotation of the table 11 and spaced from the latter axis in a direction opposite the direction of rotation of the table, indicated by the arrow B in Figure 1. The piston 16 is reciprocably mounted in the cyinder and is connected to the outer end of the bracket 40 by means of a rod 47. The axis of the rod 47 is coincident with the axis 46 of the cylinder and the rod extends through the inner end of the cylinder for connection with the bracket. Air is supplied to and exhausted from the cylinder at opposite sides of the piston by a fluid pressure system (not shown herein), but which may be any one of a number of well-known types.

Upon reference to Figure 2, it will be noted that the inner end of the bracket 40 is bifurcated to provide vertically spaced furcations 49 on opposite sides of the axis 46 of the cylinder. The inner end portions of the furcations 49 are apertured to receive a vertical pin 50 having its axis located in a plane including the axis 46 and adapted to form a fulcrum for the shoe holder 51. The shoe holder 51 has a channel-shaped groove extending longitudinally of the inner side thereof, and the shoe 13 is adapted to be secured in this groove. The outer side of the shoe holder is formed with a V-shaped vertically extending groove 53 having a transversely curved bottom portion adapted to bear against

the pin 50 and provide for swinging movement of the shoe holder in a horizontal plane. The construction is such that the horizontal plane of swinging movement of the shoe holder also includes the plane of rotation of the templet frame and, as a consequence, the shoe 13 will accurately register with the recess 12 in the perimeter of the templet frame.

Owing to the fact that the pin 50 is located on the axis 46 of the cylinder and, inasmuch as the axis 46 is offset laterally from the axis of rotation of the table 11 in a direction opposite to the direction of rotation of this table, it follows that the bending pressure is applied to the strip of stock on the templet frame before the stock is advanced through a vertical plane including the axis of rotation of the table and parallel to a plane which includes the axis 46 of the cylinder. This arrangement is particularly advantageous when bending the stock to the general contour noted herein, since by reason of the same, the rotative action of the templet frame assists in tensioning the strip as it is bent around the templet frame.

Attention is called to the fact that garnish molding frames of the type used in connection with the windows in motor vehicle bodies are not interchangeable from one side of the body to the other. As a consequence, it is necessary to manufacture both right and left-hand frames. The machine illustrated herein is adjusted for forming garnish molding frames adapted to be used in connection with the windows on the right-hand side of the vehicle body, and the relatively simple manner in which the machine may be operated to form left-hand molding frames is a further advantageous feature of this invention. Upon reference to Figure 1, it will be noted that the opening 23 in the plate 24 for receiving the hub 22 is elongated in a direction transversely of the axis or line of action 46 of the cylinder. The arrangement is such as to permit the hub and table assembly to be shifted from the position thereof shown in Figure 1 to a position wherein the axis of rotation of the table assumes a location designated by the reference character 60. This shifting movement of the hub is effected without disturbing the driving pinion 31 by locating the axis of this pinion in a vertical plane including the axis 46 of the cylinder and by moving the hub along an arc 62 having a radius centered on the axis of rotation of the driving pinion. Thus, the hub and table assembly is, in effect, pivoted about the driving pinion until the axis of rotation of the table assumes the position designated by the point 60 in Figure 1. The table is formed with an additional set of openings 63 for cooperation with the fastener elements 26 to secure the parts in their shifted position.

Referring again to Figure 1, it will be noted that the geometry of the machine is such that a line, forming a continuation of the axis 46 of the cylinder, passes midway between the two optional axes of rotation of the table. As a consequence, when the table is rotated in the opposite direction from the one designated by the arrow B to form a left-hand garnish molding frame, the relationship between the point of application of bending pressure on the strip and the axis of rotation of the table remains the same as previously described. It will, of course, be understood that the templet frame 10 must be inverted, or interchanged, for a frame capable of producing a left-hand garnish molding frame.

What I claim as my invention is:

1. In a machine for bending strip stock to form a closed frame of predetermined longitudinal contour, a templet frame having a side surface corresponding in shape to said predetermined longitudinal contour, compressible means positioned opposite the side surface of the templet frame and cooperating with the latter to clamp a strip of stock to the surface aforesaid of the templet frame, means for rotating the templet frame relative to the compressible means to effect a bending of the strip of stock around said contour surface of the templet frame, and means for adjusting the templet frame in the plane of the same to vary the position of the axis of rotation of the templet frame relative to the line of action of the force applied against the stock by said compressible means.

2. In a machine for bending strip stock to a predetermined longitudinal contour, a revoluble templet provided with a side surface having a shape corresponding to said predetermined longitudinal contour, compressible means cooperating with the side surface of the templet to clamp a strip of stock against said surface and positioned to apply the clamping pressure on a line offset from the axis of rotation of the templet in the plane of rotation of the latter, means for rotating the templet in opposite directions relative to the compressible means, and means for adjusting the templet in the plane of rotation of the same to maintain a corresponding relation between the line of action of the compressible means and axis of rotation of the templet irrespective of the direction of rotation of said templet.

3. In a machine for bending strip stock to form a substantially closed frame of predetermined longitudinal contour, a revoluble templet frame having a shape corresponding to said predetermined longitudinal contour, a member positioned opposite the templet frame and cooperating with the latter to yieldably clamp a strip of stock therebetween, compressible means acting on said member to maintain a clamping pressure on the stock during rotation of the templet and positioned to apply said clamping pressure on a line offset from the axis of rotation of the templet in the plane of rotation of the latter, means for rotating the templet frame in opposite directions relative to the member to effect bending of the strip of stock around the templet frame, and a support for the templet frame adjustable to selectively locate the axis of rotation of the templet frame on opposite sides of the line of force exerted by the compressible means to maintain a corresponding relation between the axis of rotation of the templet frame and line of force irrespective of the direction of rotation of said frame.

4. In a machine for bending strip stock to a predetermined longitudinal contour, a templet frame rotatable in one direction about one axis and rotatable in the opposite direction about another axis spaced laterally from the axis aforesaid, a member positioned opposite the templet frame and cooperating with the latter to yieldably clamp a strip of stock therebetween, and compressible means exerting a pressure on said member along a line extending between the two axes of rotation of the templet frame and in a direction to maintain a clamping pressure on the stock during rotation of the templet.

5. In a machine for bending strip stock to a predetermined longitudinal contour, a revoluble templet having a side surface corresponding in shape to said predetermined longitudinal contour, a member positioned opposite the side surface of the templet and cooperating with the latter to yieldably clamp a strip of stock therebetween, compressible means exerting a pressure on said member along a line offset from the axis of rotation of the templet in the plane of the same and in a direction opposite the direction of rotation, and means for adjusting the templet in the plane of rotation of the same to locate the axis of rotation on the opposite side of the line of force applied to the templet by said compressible means.

6. In a machine for bending strip stock to a predetermined longitudinal contour, a templet selectively rotatable in opposite directions about axes spaced from each other, a member positioned opposite the templet and cooperating with the latter to yieldably clamp a strip of stock therebetween, compressible means acting on the member to maintain a clamping pressure on the stock during rotation of the templet and applying said pressure along a line extending midway between the alternative axes of rotation of the templet, and common means for rotating the templet about either of said axes.

7. In a machine for bending strip stock to a predetermined longitudinal contour, a table supported for rotation in opposite directions, a templet secured to one side of the table and having a side surface corresponding in shape to said predetermined longitudinal contour, a member positioned opposite the templet and cooperating with the latter to yieldably clamp a strip of stock therebetween, compressible means acting on said member to maintain a clamping pressure on the stock during rotation of the table and adapted to exert said clamping pressure on a line laterally offset from the axis of rotation of the table in a direction opposite the direction of rotation of the table, means for rotating the table including a gear secured to the opposite side of the table in concentric relation to the axis of rotation of said table, a pinion meshing with said gear, and means supporting said table for swinging movement about the axis of the pinion to locate the axis of rotation of the table on the opposite side of the line of force when the table is rotated in the other direction.

8. In a machine for bending strip stock to a predetermined longitudinal contour, a table revoluble in opposite directions, a templet frame secured to one side of the table with the side walls non-symmetrically arranged with respect to the axis of rotation of the table and having a shape corresponding to said predetermined longitudinal contour, a member positioned opposite the templet and cooperating with the latter to yieldably clamp a strip of stock therebetween, compressible means acting on said member to maintain a clamping pressure on the stock during rotation of the templet and adapted to apply said clamping pressure on a line laterally offset from the axis of rotation of the table in a direction opposite the direction of rotation of said table, a gear secured to the opposite side of the table in concentric relation to the axis of rotation of the latter, a driving pinion meshing with said gear for rotating the table, and means for swinging the table about the axis of the driving pinion to locate the axis of rotation of the table on the opposite side of the line of force of said compressible means when the table is rotated in the other direction.

9. In a machine for bending strip stock to a predetermined longitudinal contour, a templet selectively rotatable in opposite directions and provided with a side surface having a shape corresponding to said predetermined longitudinal contour, compressible means cooperating with the side surface of the templet to clamp a strip of stock against said surface and positioned to apply the clamping pressure on a line offset from the axis of rotation of the templet in the plane of rotation of the same, and means for relatively adjusting the position of the templet and compressible means in the plane of rotation of the templet to maintain a corresponding relation between the line of action of the compressible means and axis of rotation of the templet for different directions of rotation of the templet.

ALLEN R. KELSO.