Sept. 8, 1953

R. E. SMITH, SR

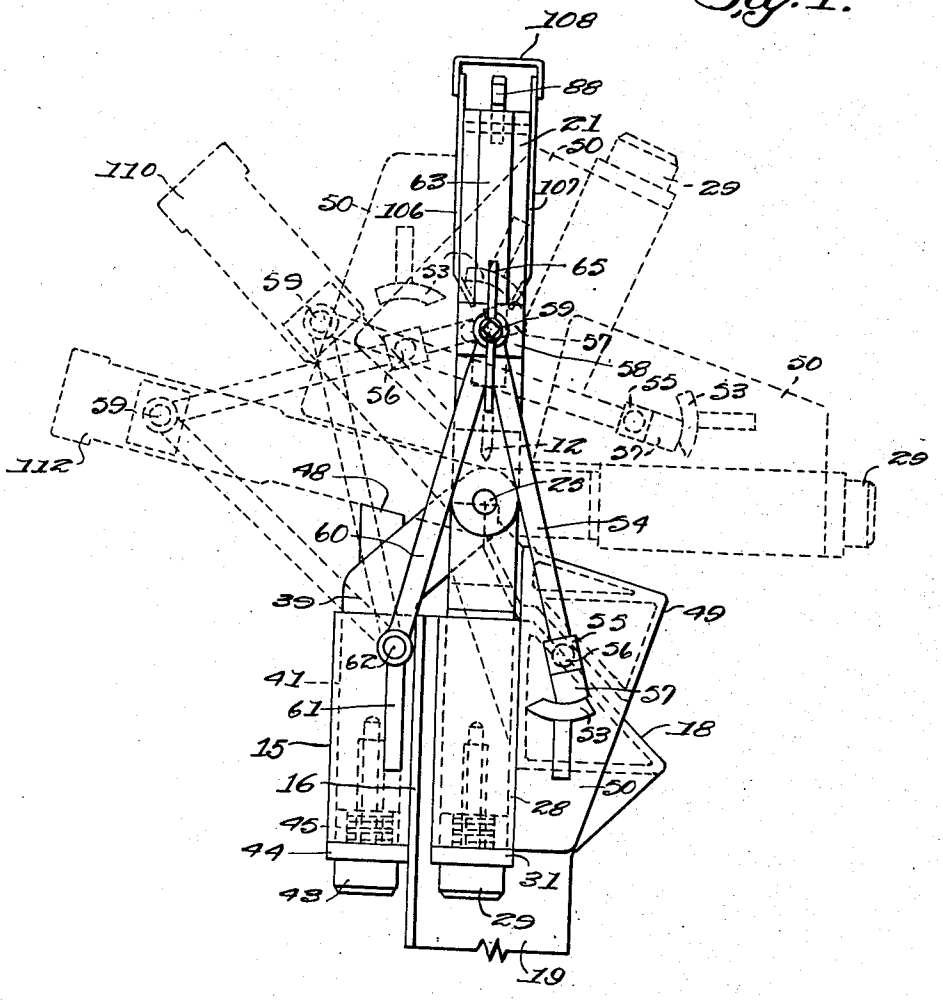
2,651,349

SHEET METAL BENDING BRAKE

Filed Aug. 9, 1950

6 Sheets-Sheet 1

Fig. 1.



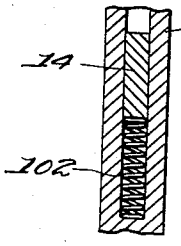


Fig. 10.

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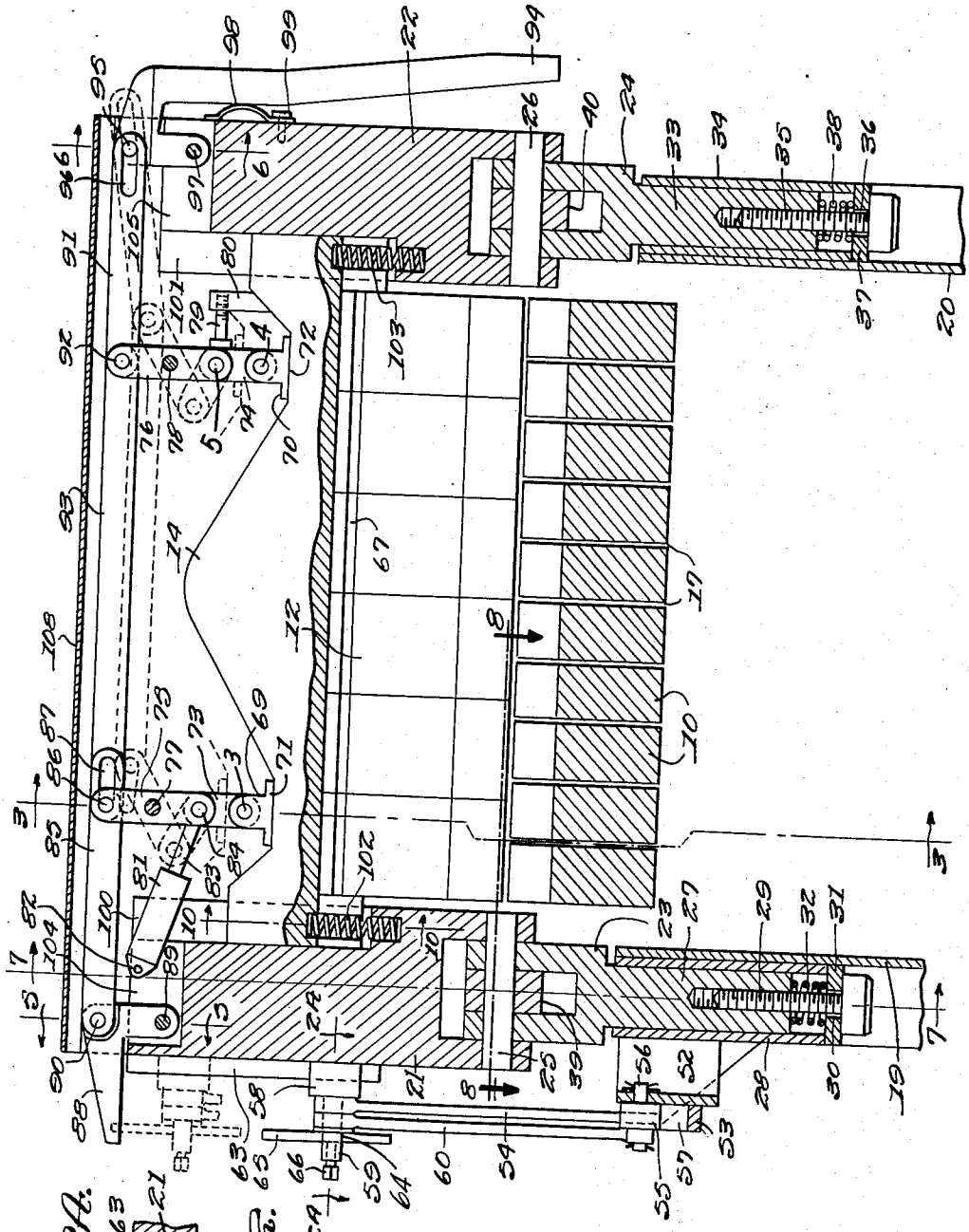

Fig. 2A.

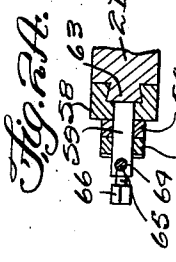

Fig. 2.

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Fig. 3.

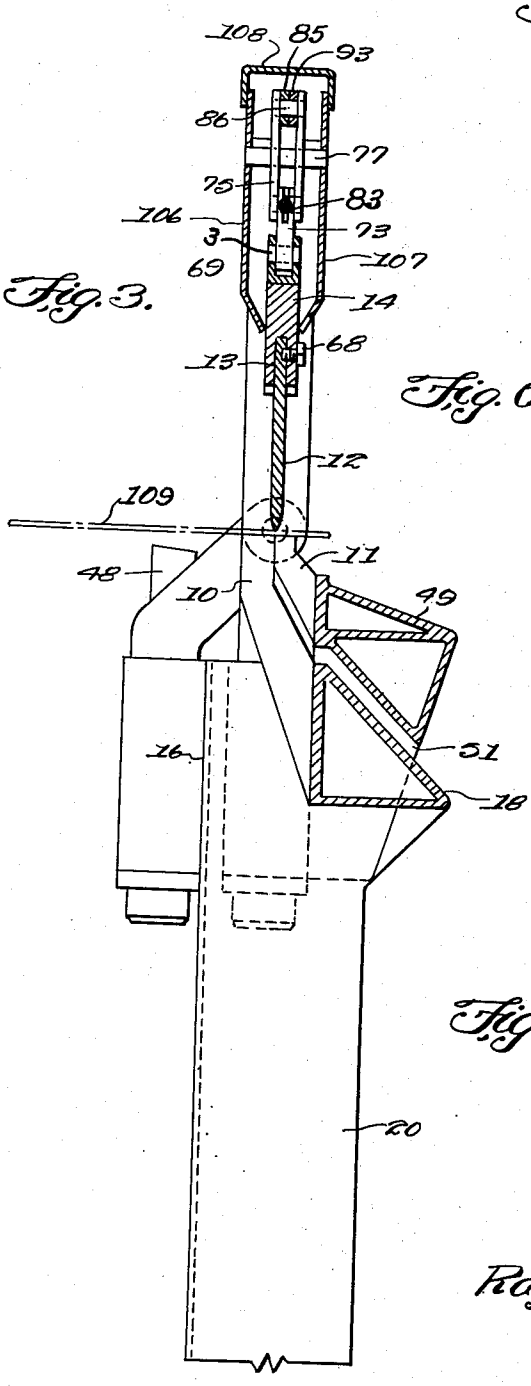


Fig. 5.

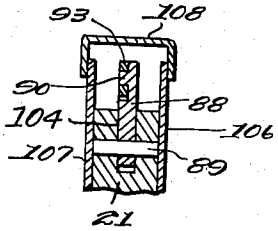


Fig. 6.

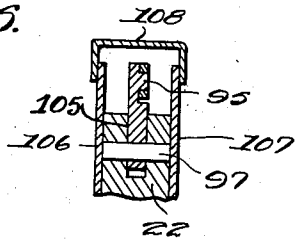
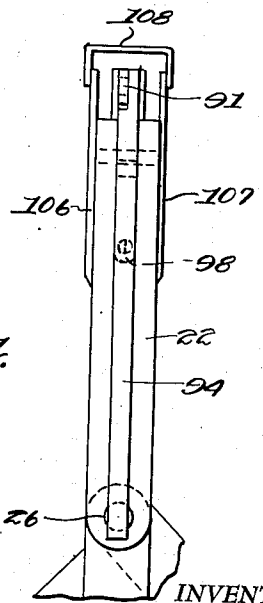


Fig. 4.



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Sept. 8, 1953 R. E. SMITH, SR 2,651,349

SHEET METAL BENDING BRAKE

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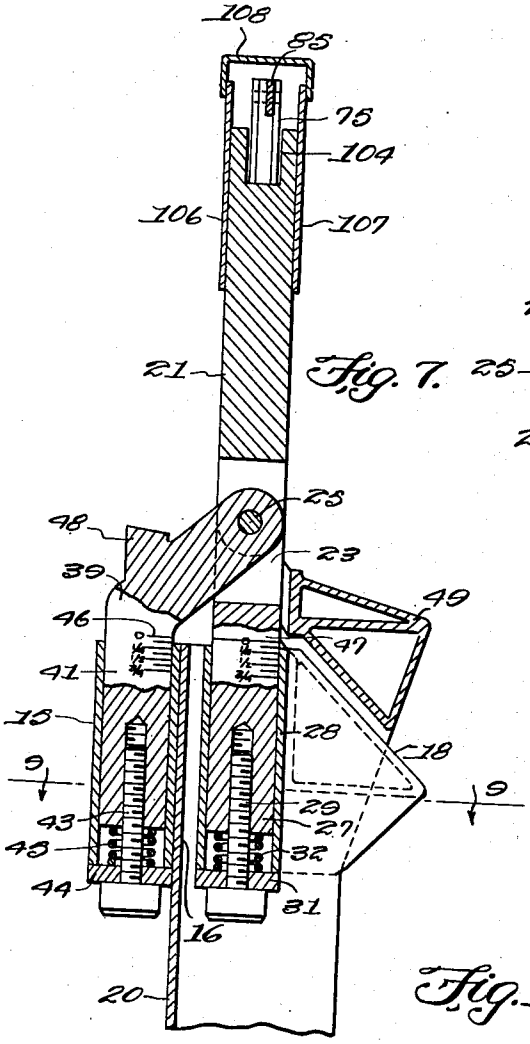


Fig. 7.

Fig. 8.

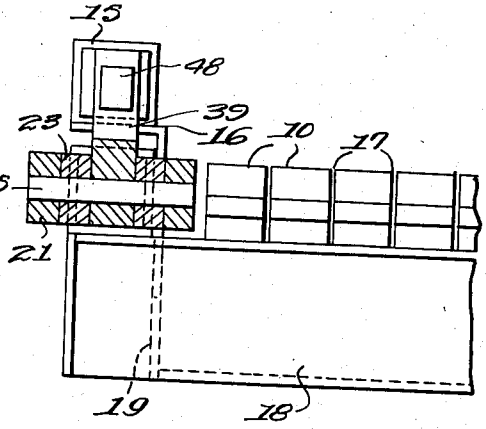


Fig. 16.

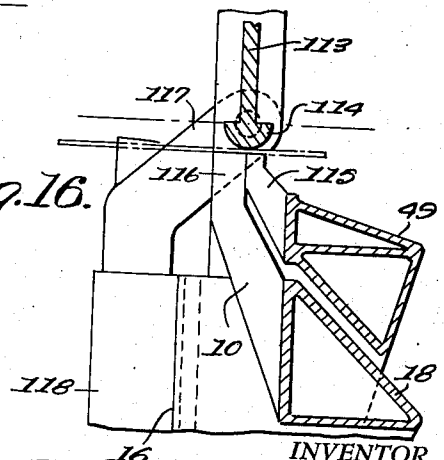
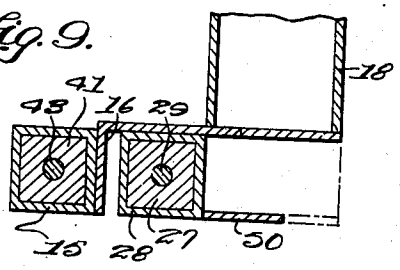


Fig. 9.



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SHEET METAL BENDING BRAKE

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Fig. 11.

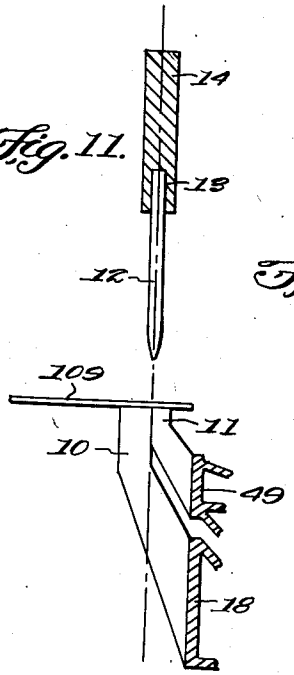


Fig. 12.

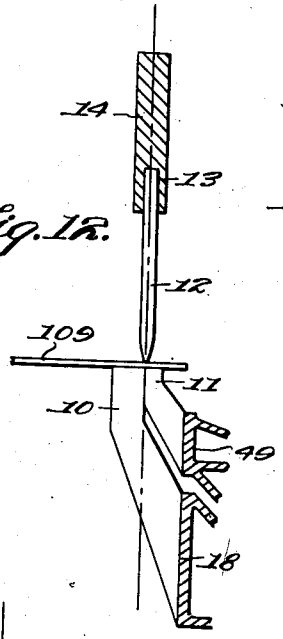
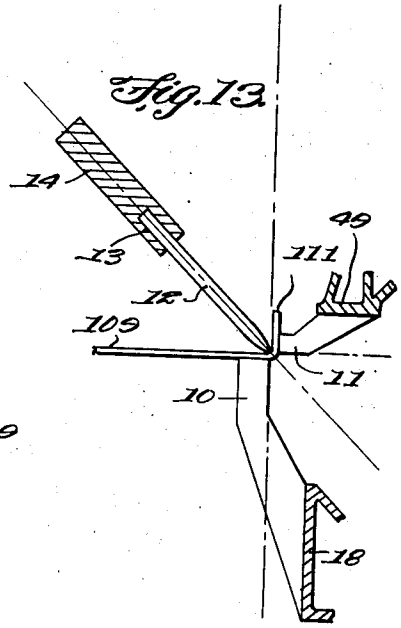


Fig. 13.



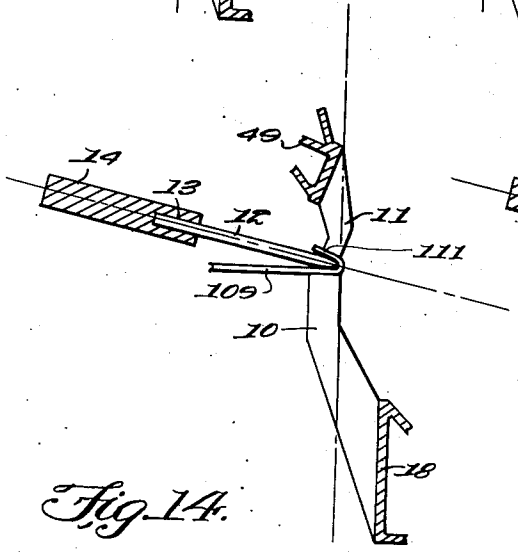


Fig. 14.

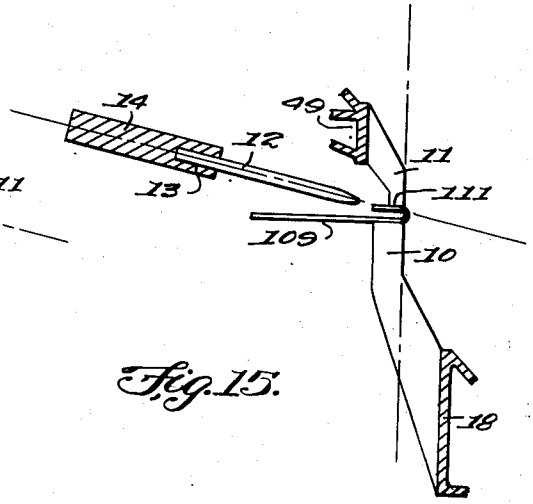


Fig. 15.

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SHEET METAL BENDING BRAKE

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FIG. 18.

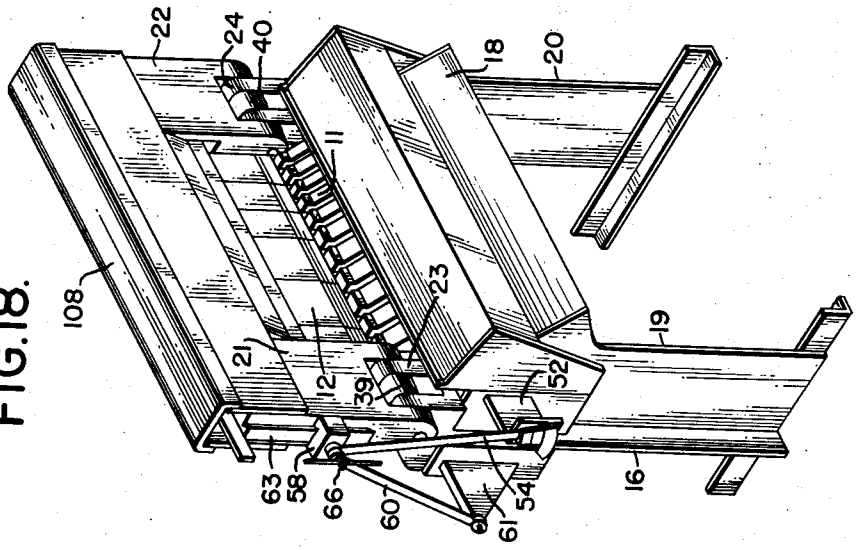
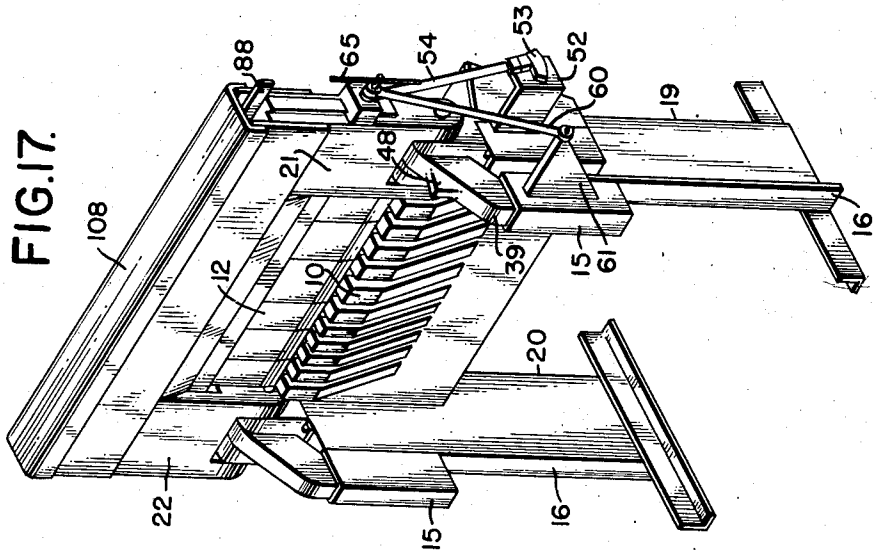


FIG. 17.



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UNITED STATES PATENT OFFICE

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SHEET METAL BENDING BRAKE

Raymond E. Smith, Sr., Waukegan, Ill.

Application August 9, 1950, Serial No. 178,381

7 Claims. (Cl. 153—16)

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This invention relates to a new and improved tool for bending sheet metal, plate or bars to various angles of bend and with various corner radii of bend. It is particularly adapted to bending narrow folds and flanges to 180 degrees (plus) in one operation after the material has been positioned between a mandrel and two anvils. In particular to a plate or sheet bending tool having a stationary anvil with an auxiliary anvil and a swingable mandrel, whereby with a plate positioned upon the anvils the mandrel is brought to an operative position above the plate and the auxiliary anvil is actuated whereby the plate or sheet is bent upwardly against the mandrel and as the travel of the auxiliary anvil continues the upwardly bent section or edge of sheet or plate is bent over with the mandrel turning at one-half the pace of the auxiliary anvil to such a position whereas the mandrel is caused to be withdrawn automatically and wherein the auxiliary anvil bends the edge of the plate downwardly to a position substantially parallel to the body of the plate.

In this invention the mandrel is unlike the conventional brake or bending tool in that it is swingable upon a common axis with the auxiliary anvil and connected by a novel linkage to both anvils in a precalculated manner so that the mandrel moves at one-half the pace of the auxiliary anvil whereby at all times the center line of the mandrel bisects the angle formed by the top surfaces of the opposing anvils and maintains this direct relation up to a certain point whereas the mandrel is made to automatically retire from the forming operation and the two anvils complete the bend without assistance of the mandrel.

In the usual type of sheet metal brake or plate bending tool it is difficult to form the edge of the material through an angle of 180 degrees without repositioning the material in the machine and this requires set up time which is not only costly but multiplies the possibility of making mistakes. With this thought in mind this invention contemplates a sheet metal bending tool in which a movable part of an anvil and a mandrel are pivotally mounted on the frame in which a stationary anvil is positioned and in which means is provided for actuating the mandrel as the bending section of the anvil is actuated.

The object of this invention is, therefore, to provide means for forming an improved plate bending tool whereby cleats, hems and the like, are completely formed on the edges of plates in repeat production.

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Another object of the invention provides for simple and positive adjustment between the mandrel and anvil surfaces for various gauges or bend radii by a unique hinge bracket slidable within a sleeve or housing held in position by a screw and compressible spring, the spring keeping it in its extended position while the screw allows adjustments to height and secures the hinge to the anvil members. The axis of the mandrel and auxiliary anvils being the same this will remain the same at any setting of the screw. This provides for free pivotal action of the mandrel and auxiliary anvil. The greater the bend radius and the thicker the metal the further this center axis is moved from the anvil surfaces (like enlarging the centers of a drafting compass). To make up for various radius bends a mandrel nose of that radius has to be provided.

With these and other objects and advantages in view the invention embodies an anvil formed of a plurality of spaced sections with mandrel supporting frames pivotally mounted at the ends of the anvil and with means for actuating the bending section of the anvil and mandrel for forming the edges of a plate positioned on the anvil in different shapes.

Other features and advantages of the invention will appear from the following description taken in connection with the drawings wherein:

Figure 1 is an end elevational view of the improved plate bending tool showing the mounting parts of the mandrel and auxiliary anvil in progressive steps in dotted lines.

Figure 2 is a vertical longitudinal section through the plate bending tool showing the mandrel in the plate gripping position.

Figure 2*a* is a detail showing a section taken on line 2*a*—2*a* of Figure 2 illustrating a cross head to which actuating links of the mandrel and bending anvil are connected to a cross head on one end of the machine.

Figure 3 is a vertical cross section through the machine taken on line 3—3 of Figure 2.

Figure 4 is a detail showing one end of the mandrel supporting head.

Figure 5 is a vertical section through the upper end of the mandrel supporting head taken on line 5—5 of Figure 2 and illustrating the lever connections therein.

Figure 6 is a similar detail taken on line 6—6 of Figure 2.

Figure 7 is a vertical cross section through the tool taken on line 7—7 of Figure 2.

Figure 8 is a detail showing a section taken on line 8—8 of Figure 2 illustrating the pivotal

connection and showing a section of the mandrel.

Figure 9 is a sectional view taken on line 9—9 of Figure 7 showing the stationary anvil and mandrel adjustable supporting elements.

Figure 10 is a detail illustrating a slot in the inner edges of blocks 12 and 13 in which the ends of mandrel holder 14 are mounted.

Figure 11 is a detail illustrating the mandrel positioned above the plate with the plate resting upon the stationary and auxiliary anvils.

Figure 12 is a similar view showing the mandrel lowered to a position upon the plate.

Figure 13 illustrates the position of bend that has progressed up to approximately 90 degrees by actuating the auxiliary anvil with the mandrel keeping its half-pace and maintaining its bisecting position.

Figure 14 is a similar view illustrating the progress of bend in which the auxiliary anvil has bent the flange or edge of the material over and approximately against the surface of the mandrel and at which position the mandrel is made to withdraw automatically.

Figure 15 is a similar view showing the mandrel withdrawn and the auxiliary anvil completing the bend against the stationary anvil without assistance of the mandrel.

Figure 16 is a cross section through the mandrel and hinge sections showing their relation to the top surfaces of the stationary and auxiliary anvils so that larger radii may be formed by insertion of mandrel noses of the appropriate radii.

Figure 17 is a perspective view looking toward the back of the machine.

Figure 18 is a view similar to that shown in Fig. 17 looking toward the front of the machine.

Referring now to the drawings wherein like reference characters denote corresponding parts the improved plate or sheet bending tool of this invention includes three parallel beams comprising a plurality of stationary anvils 10, auxiliary or coacting anvils 11, and a plurality of mandrel sections 12 secured in a slot 13, and a holder 14, stationary tubular casings 15 mounted on flanges 16 of vertically disposed posts 19 and 20.

The stationary anvil 10 is formed with a plurality of sections with slots 17 between the sections, as illustrated in Figures 2 and 8 and these sections are carried by a hollow section or bar 18 which extends between the posts 19 and 20. The ends of the section 18 are supported by posts 19 and 20 and the superstructure in which the mandrel sections 12 are carried is pivotally supported on the upper ends of the posts by blocks 21 and 22 which are pivotally mounted in bearings 23 and 24 by pins 25 and 26, respectively.

The bearing 23 is provided with a square stem 27 that extends into a tubular casing 28 of the auxiliary anvil 11 and the stem is adjustably secured in the casing by an adjusting screw 29 that extends through an opening 30 in a head 31. The screw holds the stem against a spring 32.

The bearing 24 is mounted in a similar manner with a stem 33 thereof mounted in a tubular casing 34 on the opposite end of the anvil 11 and this is held by an adjusting screw 35 that extends through an opening 36 in a head 37 wherein the stem is held against a spring 38.

The bearings 23 and 24 are supported by arms 39 and 40 which extend upwardly from shanks 41 in tubular casings 15 which are mounted on the flanges 16. The shanks 41 with the associated parts are similar at both ends of the machine and the same reference characters are, therefore, used for both. The shanks 41 are adjustably held in the casings by adjusting screws 43 that extend through heads 44 and the shanks are resiliently urged upwardly by springs 45.

The upper outer surfaces of the shank 41 and stem 27 at one end of the machine are provided with graduations 46 and 47, respectively to facilitate setting the mandrel and supporting elements in relation to the anvils 10 and 11, respectively. The arm 39 is provided with a stop 48 that is positioned to arrest the downward movement of the block 21 in which one end of the mandrel is supported.

The auxiliary swingable anvil 11 is also formed with spaced sections having slots between the sections and the sections of this anvil are carried on a cross member 49, the ends of which are secured to the tubular casings 28 and 34 by side plates 50 and 51, respectively, which extends from the outer peripheral edge of the cross member 49 to the tubular casing 28, as illustrated by the dotted lines, in Figures 3 and 7.

The plate 50 at the end of the machine is provided with a bracket 52 having an arcuate shoe 53 thereon and a link 54, the lower end of which is slidably mounted in a bearing 55 which is pivotally mounted in the bracket 52 on the pin 56. The lower end of link 54 is provided with a head 57 that rides against the inner surface of the shoe 53, as shown in Figure 1 up to a point of bend as shown in Figure 14 where it retires from the shoe permitting continued movement of auxiliary anvil 11. The upper end of the link 54 is pivotally mounted on a cross head 58 by a pin 59 on which a supporting link 60 is also pivotally mounted. The lower end of the link 60 is pivotally mounted on a bracket 61 extended outwardly from the casing 15, by a pin 62.

The cross head 58 is slidably mounted on a dove-tailed tongue 63 on the outer surface of the block 21. The pin 59 is provided with an opening 64 through which a rod 65 extends and the rod is adjustably set to trip lever 88 as the cross-head 58 moves upward on block 21. This rod is mounted in the opening in the outer end of pin 59 by a set screw 66.

The upper mandrel sections 12 are removably mounted in the slot 13 of the vertically slidable plate 14 and the upper ends of the mandrel sections are provided with slots 67 by which they are secured in position by set screws 68, as shown in Figure 3. The nose at the lower end of the mandrel is substantially semi-circular in cross section, the center of the radius thereof being positioned on the center of the radius of the bend of the work.

The upper edge of the plate 14 is formed, as illustrated in Figure 2, and the mandrel 12 is forced downwardly with the jack-knife or toggle acting levers including the lower link or sections 73 and 74 and the upper links or sections 75 and 76. The bearing blocks 69 and 70 are positioned in recesses 71 and 72 of the blade 14. The toggle levers and links are actuated from the positions shown in full lines to the positions shown in dotted lines by the hand lever 94 when it is desired to elevate the mandrel 12.

A screw 79, threaded in a projection 80 extended upwardly from the plate provides a stop for the lever 76 and link 74, and the lever 75 and a link 73 are held by the fluid or air pressure cylinder 81 which also provides a shock absorber to hold in check the rapid collapse of the toggle element when it is tripped by the trip lever 88 or hand lever 94. This cylinder 81 can also be used

to reset toggle elements when hooked up with a source (not shown) of fluid pressure. The cylinder 81 is pivotally mounted in slot 104 in the block 21 by a pin 82 and the outer end is provided with a piston rod 83 which is pivotally connected to the pin 84 by which the link 73 is connected to the lever 75.

The upper end of the lever 75 is connected to a link 85 by a pin 86 with the pin positioned in a slot 87 in the end of the link and the opposite end of the link is connected to a trip lever 88 by a pin 90, which lever is released by contact of rod 65. This trip lever 88 is pivotally mounted on a pin 89, spanning slot 104 in block 21.

A similar link 91 is pivotally connected to the upper end of the lever 76 by a pin 92 and a link 93 connects the links 85 and 91, the ends of the link 93 being pivotally mounted on the pins 86 and 92. The outer end of the link 91 is connected to a hand lever 94 by a pin 95 in a slot 96 and the lever 94 is pivotally mounted in the block 22 by a pin 97. A spring 98, which provides a cushion for the hand lever 94 is attached to the end of the block 22 by a screw 99.

The ends of the plate 14 are slidably mounted in slots 100 and 101 in the inner faces of the blocks 21 and 22 and the ends of the plate are resiliently urged upwardly by springs 102 and 103. The upper ends of the blocks 21 and 22 are provided with slots 104 and 105 in which the trip lever 88 and hand lever 94 are positioned, respectively.

Side plates 106 and 107 are provided on the sides of the blocks 21 and 22 and the upper edges of the side plates are connected by a channel shaped cap 108. The side plates 106 and 107 extend from the outer ends of the blocks 21, at one end of the machine to the outer ends of the blocks 22 at the opposite end of the machine. The pins 77 and 78 on which the levers 75 and 76, respectively, are pivotally mounted are supported in the side or cover plates 106 and 107, as shown in Figure 3.

The link 73 is pivotally connected to the bearing 69 with a pin 3, and the link 74 is pivotally connected to the bearing 70 with a pin 4 and to the lever 76 with a pin 5.

The upper movable mandrel and auxiliary anvil may be actuated by hand or other suitable means.

With the parts arranged as shown and described a sheet of material, as indicated by the numeral 109 is placed upon the stationary and auxiliary anvils 10 and 11 with the mandrel in the upwardly extended position, as shown wherein the toggle levers are in the position shown in dotted lines in Figure 2, and by drawing the hand lever 94 outwardly the levers are actuated to the full line positions wherein the mandrel 12 is moved downwardly to the position shown in Figure 12.

By pressing lever 94 inward toward block 22 mandrel is released to its original position if it is so desired to reposition work or to release mandrel at any point in the bending operation. The auxiliary anvil with the cross member 49 is moved upwardly and as this is moved upwardly the link 54, the lower end of which is in engagement with the shoe 53, moves the superstructure over to the dotted line position indicated by the numeral 110, in Figure 1 wherein the mandrel is positioned at substantially 45 degrees to the face of the anvil 10, as shown in Figure 13. In this movement the auxiliary anvil 11 bends the edge of the blade upwardly forming a flange 111 which is positioned at right angles to the body of the plate with continued movement of the auxiliary anvil 11 the mandrel moves to the position shown in Figure 14 with the superstructure coming to a stop in the position indicated by numeral 112, in Figure 1. At this point two things happen, trip lever 88 is contacted by pin 65, which has moved outward along block 21 guided by slidable head 58 toward trip lever 88, thereby tripping toggle elements which automatically withdraw mandrel from the forming operation and the head 57 of link 54 leaves the arcuate shoe 53 allowing continued movement of the auxiliary anvil which bends the material downward to a position substantially parallel with the body of the plate between the two anvil structures as illustrated in Figure 15. By this means a comparatively simple operation bends the edge of the plate upwardly and over to form a hem or bead wherein the flange or edge of the plate may be moved through an angle greater than 180 degrees.

From the foregoing description it will be obvious that an improved plate bending machine is provided wherein a plate, as indicated by the numeral 109, is positioned on stationary and movable anvils 10 and 11, as illustrated in Fig. 3 and with the mandrel 12 positioned against the upper surface of the plate, the superstructure is moved over in a counterclockwise direction whereby the cross member 49 moves the anvil 11 upwardly through the steps illustrated in Figs. 11 to 15. During this movement the mandrel 12 travels continuously assuming successive positions, each of which bisects the angle between the stationary and movable anvils, as illustrated in Fig. 13 whereby the material is held against the anvil continuously until it is substantially formed to an angle of 180°.

With the superstructure in which the mandrel 12 is carried pivotally mounted with the offset arms extended from a tubular casing 15 which are mounted on the posts 19 and 20 through the brackets 16, the lower anvil remains stationary whereas the movable anvil travels about the pivot on the axis of the pins 25 and 26 whereby the edge of the plate is formed against the mandrel. With the parts mounted in this manner it is possible to accurately adjust the position of the mandrel and also the position of the movable anvil in relation to the stationary anvil whereby accurate bends are obtained and with the pivots offset in this manner it is possible for the mandrel to follow through the entire bending operation with the mandrel in successive positions, each of which bisects the angle between the forming anvils.

It will be understood that the anvils and mandrel may be provided in different shapes and designs so that plates may be bent to different forms, and in Figure 16 the mandrel 113 is shown with an arcuate or semi-circular head 114 and as an auxiliary anvil 115 is actuated, similar to the anvil 11 a plate may be formed around the arcuate surface of the head 114 of the mandrel. In this design the machine is provided with a stationary anvil 116 and the superstructure is pivotally mounted in arms 117 carried by tubular casings 118 similar to the casing 15.

It is understood that radius bends up to semi-circular arcs can be formed around a mandrel like in Figure 16 without change in any part of bender otherwise than a simple adjustment of the screws 29—35 and 43—43 within the stems 27—33 and shanks 41—41 respectively, and the

selection of an interchangeable mandrel 113—114 fitting the form desired.

It will be understood that other modifications may be made in the design and arrangement of the parts without departing from the spirit of the invention.

What is claimed is:

1. A brake comprising spaced vertically disposed posts, a horizontally disposed stationary anvil extended between and connecting the upper ends of the posts, bearings carried by the posts and extended to points whereby the axes of the bearings are aligned with the point of bend of a plate formed by the brake and positioned on the upper surface of the stationary anvil, a coacting anvil having an upper surface in the plane of the upper surface of the stationary anvil and a face positioned in meeting relation with the face of the stationary anvil, a frame positioned above the anvils, means whereby the coacting anvil and frame are pivotally mounted in said bearings extended from the posts and wherein the pivot point of the coacting anvil and frame is in alignment with the axes of the bearings, a mandrel carried by the frame and positioned to engage a plate positioned on the anvils, and means whereby the frame with the mandrel therein is rotated upon rotation of said coacting anvil whereby the mandrel is positioned to bisect the angle between the stationary and coacting anvils.

2. A brake comprising spaced vertically disposed posts, a horizontally disposed stationary anvil extended between and connecting the upper ends of the posts, bearings carried by the posts and extended to points whereby the axis of the bearings are aligned with the point of bend of a plate formed by the brake and positioned on the upper surface of the stationary anvil, a coacting anvil having an upper surface in the plane of the upper surface of the stationary anvil and a face positioned in meeting relation with the face of the stationary anvil, a frame positioned above the anvils, means whereby the coacting anvil and frame are pivotally mounted in said bearings extended from the posts and wherein the pivot point of the coacting mandrel and frame is in alignment with the axes of the bearings, a mandrel carried by the frame and positioned to engage a plate positioned on the anvils, and means whereby the frame with the mandrel therein is rotated upon rotation of said coacting anvil whereby the mandrel is positioned to bisect the angle between the stationary and coacting anvils, said anvils and mandrel being formed in sections.

3. A brake as described in claim 1, wherein the mandrel is mounted to slide vertically in the frame and means is provided for urging the mandrel downwardly in clamping relation with a plate on the anvils.

4. In a brake as described in claim 1, means mounting the mandrel in the frame whereby the mandrel is adapted to slide vertically in the frame, toggle elements mounted in the frame and positioned to coact with the mandrel, and a hand lever pivotally mounted on the frame for actuating the toggle elements.

5. A brake as described in claim 2, in which the frame includes blocks pivotally mounted in the bearings, and a plate mounted to slide vertically in the blocks with the mandrel sections carried by the plate, and with the plate actuated with a hand lever through toggle elements to clamp a plate on said anvils.

6. A brake as described in claim 2, wherein resilient elements are incorporated in the connections of the bearings to the posts.

7. A brake as described in claim 2, in which the travel of the frame and mandrel is controlled by a link pivotally connected at one end to supporting means on one of said posts and at the other to the frame, and in which the travel of the coacting anvil is controlled by a link, pivotally connected at one end to the frame and at the other, to the coacting anvil.

RAYMOND E. SMITH, Sr.

References Cited in the file of this patent

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