Nov. 10, 1942. E. SACHSE ET AL 2,301,643

APPARATUS FOR WORKING SHEET METAL

Filed Feb. 11, 1939 5 Sheets-Sheet 1

Fig.1

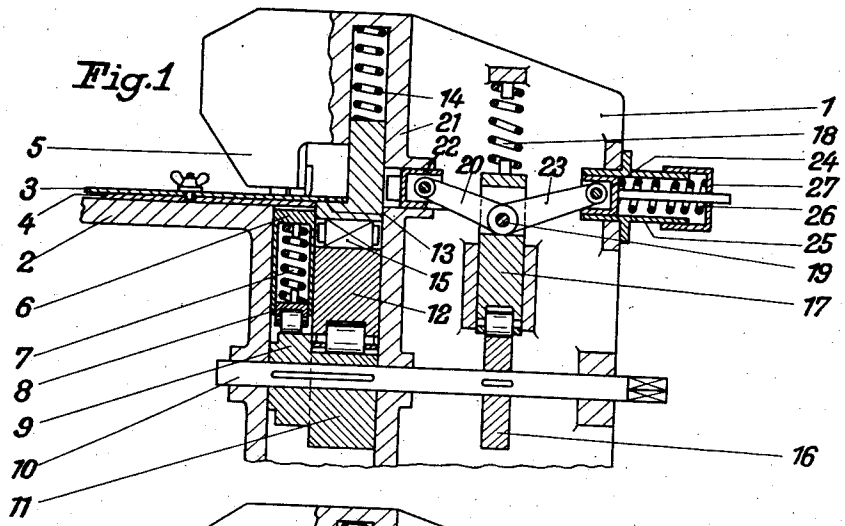


Fig.2

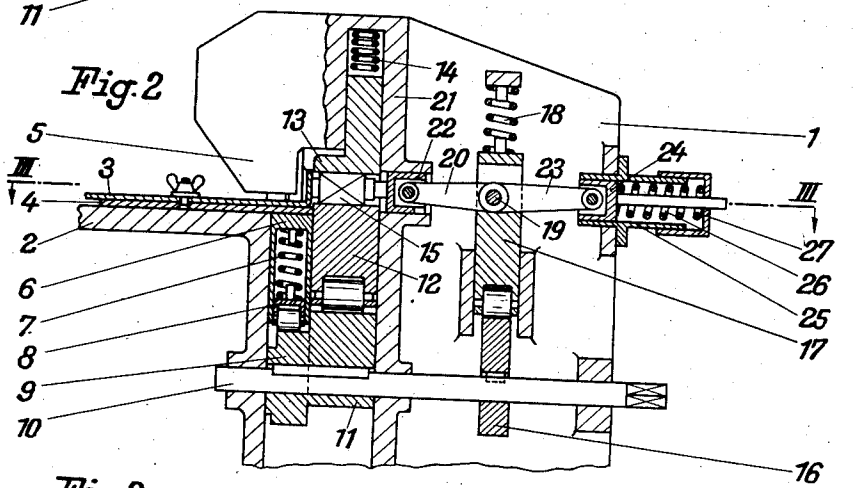
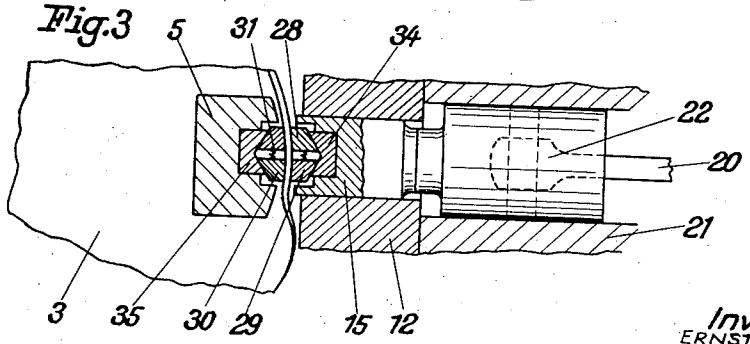


Fig.3



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APPARATUS FOR WORKING SHEET METAL

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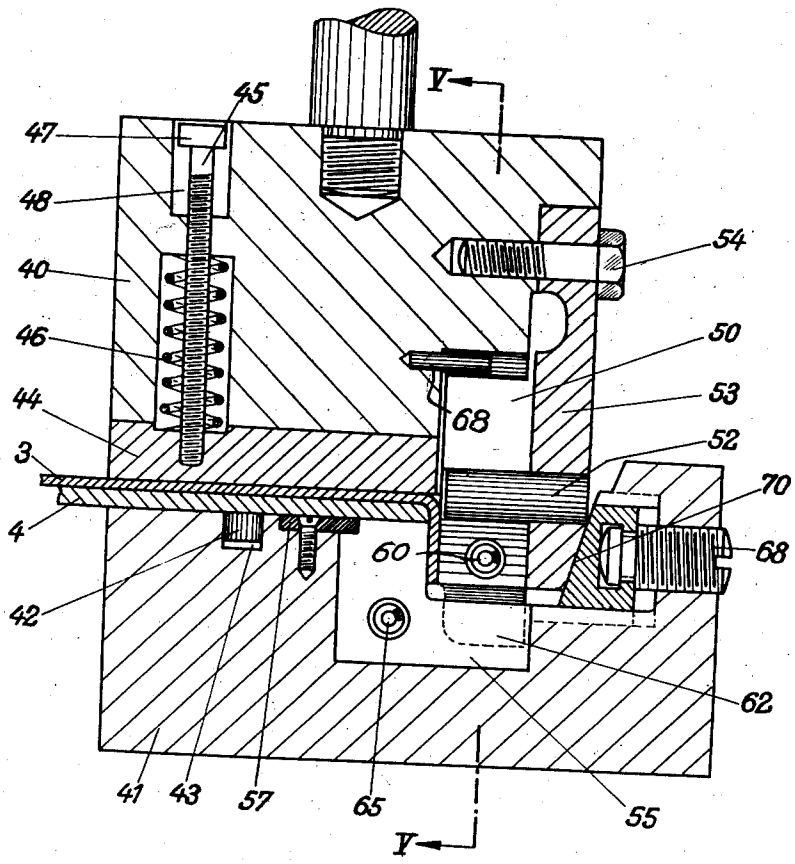
Fig.4



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APPARATUS FOR WORKING SHEET METAL

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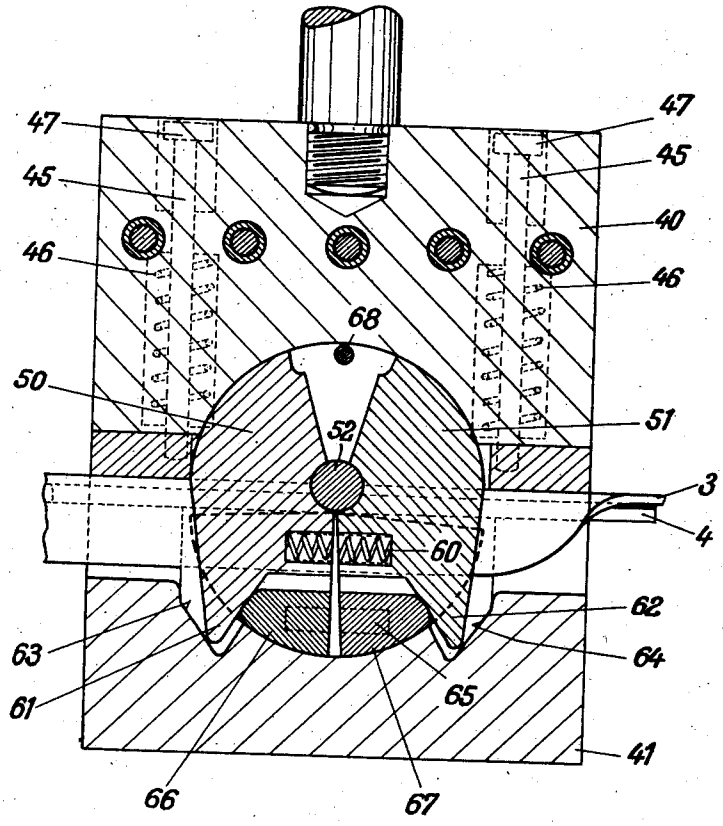
Fig.5



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APPARATUS FOR WORKING SHEET METAL

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Fig. 7

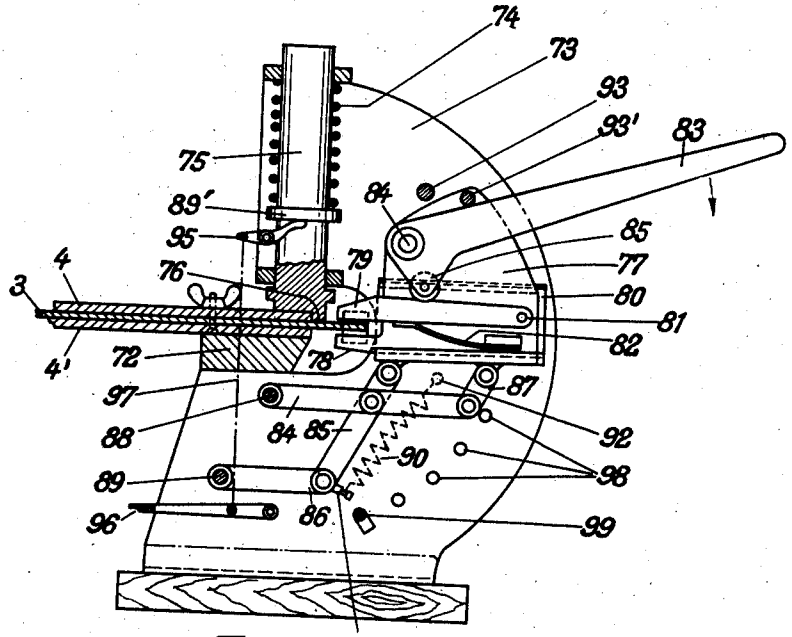
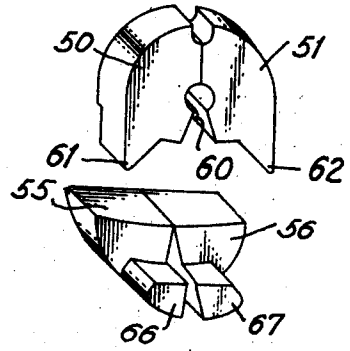


Fig. 6



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APPARATUS FOR WORKING S ET METAL

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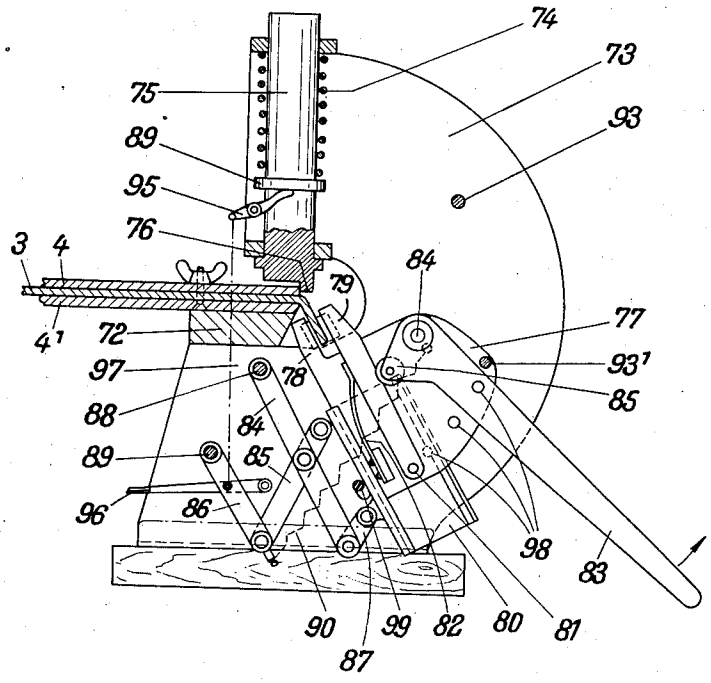
Fig. 8



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UNITED STATES PATENT OFFICE

2,301,643

APPARATUS FOR WORKING SHEET METAL

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Application February 11, 1939, Serial No. 255,910
In Germany February 16, 1938

8 Claims. (Cl. 153—25)

The present invention relates to an apparatus for working sheet metal and particularly relates to apparatus for edging or flanging sheet metal.

Although not specifically limited thereto, the present invention will be particularly described in connection with an apparatus for bending and flanging the edges of sheet metal pieces of irregular or curved outlines.

With pieces of sheet metal with irregular outlines, considerable difficulty has been experienced in properly flanging the edges of the same.

Where this flanging has been accomplished by clamping the piece with the edge to be flanged protruding, followed by hammering over such protruding edge with a hammer, there is a tendency for the metal to fold due to resilient shortening of the periphery thereof.

With irregular shapes or curves, this difficulty becomes very marked and considerable labor and skill of manipulation are required before a satisfactory flanged piece is produced.

In accomplishing this flanging by machines having a pair of interchangeable adjustable forming rollers between which the edge of the plate or piece of sheet metal is inserted, it is necessary to perform the flanging by a repeated number of passes through or between the rollers with the plate being bent only at a slight angle on each pass.

Between each pass, it is necessary to readjust the forming rollers or even to replace such rollers until the desired angular flange is obtained but with such rollers, it is only readily possible to apply this flanging procedure to pieces of circular or cylindrical contour, as for example, cylindrical sheet metal bodies or the circular bottoms of containers, and so forth.

Furthermore, it has not been found most satisfactory to flange sheet metal pieces or plates by drawing procedures due to the expense of the dies, this drawing procedure being satisfactory and economical only where very large quantities of pieces of the same shape are flanged.

It is among the objects of the present invention to provide improved apparatus for flanging sheet metal edges, which are particularly applicable to plates or pieces of sheet metal having irregular, curved edges and which may be accomplished without skillful manipulation and the minimum of labor and the maximum economy in production.

Another object is to provide an improved apparatus for flanging sheet metal pieces or plates which will not require the use of expensive drawing or forming dies, which will not require repeated passes through adjustable rollers and which will give a high production of flanged sheet metal objects without the necessity of skillful working to eliminate tendency toward folding because of the shortening of the periphery of the sheet metal as a result of the flanging operation.

Other objects will be obvious or will become apparent during the course of the following specification.

In accomplishing the above objects, it has been found most satisfactory, according to the present invention, to bend successive portions of the edge of the sheet metal or plate to the desired angle and simultaneously therewith, or shortly thereafter, to subject such edges to substantially compressive forces sufficient to upset said edges and eliminate any folding tendency.

In carrying out this method, it has been found most desirable to form a holder for the sheet of irregular or other contour to be flanged permitting the edge portion to protrude. This edge portion then may be flanged by a suitable die or ram to the final angle or in stages.

Following each bending operation, the flanged or bent edges are subjected to compression by an upsetting tool to eliminate any folds.

This compression device may be caused to act upon either one or both sides of the flange during or subsequent to the formation of such flange and the operation of the flanging device may be effected by the same drive mechanism which actuates the device for bending or forming the flange.

The reciprocating dies, and the flanging and upsetting and compressing devices may take the form of a pair of tongs which may be pivotally connected with the machine frame in such a way as to grasp the edge to be flanged, followed by bending, compression or upsetting of such edge during and subsequent to the bending operation.

The invention will appear more clearly from the following detailed description when taken in connection with the accompanying drawings, which illustrate preferred embodiments of the inventive idea.

In the drawings:

Figures 1 to 3 show one embodiment diagrammatically, Figure 1 being a side sectional view through the center of the device in starting position, Figure 2 being a similar view in the final position and Figure 3 being a transverse horizontal section upon the line III—III of Figure 2 upon an enlarged scale as compared to Figure 2.

Figures 4 to 6 show another embodiment, Fig-

ure 4 being a vertical transverse section of a flanging device, Figure 5 being a transverse section upon the line V—V of Figure 4 and Figure 6 being a perspective view of the upsetting or compression jaws by themselves, removed from the mechanism of Figures 4 and 5, upon an enlarged scale as compared to Figures 4 and 5.

Figures 7 and 8 diagrammatically show still another embodiment in side view and in partial section, Figure 7 showing the position of the parts at the beginning of the operation, and Figure 8 showing the position of the parts at the completion of the operation.

Referring to the devices shown upon Figures 1 to 3, the machine frame 1 carries a table 2. The sheet of metal 3, the edge of which is to be flanged, is carried by and clamped to the support plate 4, the edge to be flanged projecting beyond the edge of the plate 4.

The projecting edge of the plate 3 is then brought into position along with the support plate 4 below the structural portion or abutment 5.

Below the support plate 4 is positioned a hollow cylindrical reciprocating ram member 6 which receives the compression coil spring 7. The ram member 6, at its lower end, receives the follower 8 carrying a roller which cooperates with a cam 9.

The cam 9 is fixed to and rotates with the shaft 10 which has bearings in the machine frame 1.

The shaft 10 carries another cam 11 next to the cam 9, which cam actuates a ram 12 having a contact roller, said ram 12 having an upper step portion 13 upon which step the projecting edge of the sheet metal element 3 to be flanged is supported.

The edge of the step will abut the edge of the support plate 4. The action of the cam 11 in moving the ram 12 upwardly to flange the projecting edge of the sheet metal piece 3 will be opposed by the compression spring 14 enclosed within a recess in the frame 1. The compression spring maintains the roller of the ram 12 in contact with the cam 11 at all times.

The ram is also provided below the step 13 with a recess which receives the compression or upsetting tool 15 which is shown on larger scale in Figure 3. In the upper position of the ram 15 (shown in Figure 2), the tool 15 is situated at the side of the flanged portion of the sheet metal piece 3.

The shaft 10 also carries the cam 16, which is situated at a distance from the cam 11 and which actuates the roller of a ram 17, said ram 17 being guided by portions of the frame 1.

The ram 17 reciprocates parallel to the rams 6 and 12 and the ram is normally pressed with its roller in contact with the cam 16 by means of the compression coil spring 18 which at its other end, presses against a portion of the frame 1.

The ram or reciprocating element 17 acts upon the joint 19 of a toggle lever. The arm 20 of the toggle lever engages a reciprocating element or body 22 which is received in a recess in the wall 21 of the machine frame 1. The other arm 23 of the toggle is pivotally connected to a sliding member 24.

The sliding member 24 is held in a sleeve 25 attached to the machine frame 1 and the spring 26 normally presses such arm 23 to the left (looking in the direction of Figures 1 and 2).

The pressure of the spring 26 may be adjusted by the cap 27 which is threaded on to the outside of the sleeve 25.

When the ram 17 elevates the joint 19, as shown in Figure 2, the spring 26 will act directly against the sliding element 22 and through such element 22 upon the compression or upsetting tool 15.

The upsetting tool 15 is provided with a pair of upsetting jaws 28 and 29 which are normally pressed apart by an intervening spring member (see Figure 3).

The jaws 28 and 29 which have concave pressure faces cooperate with the jaws 30 and 31 having correspondingly shaped convex compression faces. The jaws 30 and 31 are also pressed apart by means of an intervening spring element.

The jaws 30 and 31 are carried by the abutment or extension element 5 of the machine frame so that the jaws 28 and 29 on the outside of the flange and the jaws 30 and 31 on the inside of the flange will act substantially upon the same portion of the metal.

The outside oblique or sloping surfaces of the jaws 28, 29, 30 and 31 are received in bevelled recesses and slide upon the bevelled surfaces of these recesses in the receiver elements 34 and 35.

As a result, when the jaws 28, 29, 30 and 31 are pressed together, in addition to the compression forces tending to compress the flange, there will also be horizontal forces tending to bring the jaws together.

While the pressure forces cause a clamping of the metal sheet edge, the horizontal forces cause a movement of the jaws in a direction parallel to the edge of the metal sheet and thus cause an upsetting of the flanged edge of the metal sheet 3.

In operation, the sheet metal piece to be flanged is clamped to the support plate 4 placed upon the shelf or table 2 and is then pushed forward until the front edge of the support plate 4 abuts the adjacent surface of the member 13. At this point, the edge to be flanged will be upon the top surface of the member 13.

Then the shaft 10 is caused to rotate and the ram 6 will first be elevated pressing the plate 3 beyond the edge to be flanged firmly against the bottom of the abutment 5. Then, the ram 12 is elevated and the edge portion of the plate 3 is bent upwardly against the vertical wall of the abutment 5 to the position indicated in Figure 2.

The ram 12 will continue to elevate until the upsetting tool 15 is positioned with its jaws 28 and 29 opposite the jaws 30 and 31, as shown in Figure 3.

Then, the ram 17 is elevated and it elevates the pivot point 19 of the toggle, extending the toggle and causing the follower member 22 to press the upsetting tool 15 against the flanged portion of the sheet metal piece 3.

The pressure exerted will be the pressure of the spring 26 which is acting against the extended toggle arms 20 and 23.

This pressure will have the effect of drawing together the flanged edge and also pressing it with the resultant upsetting thereof. As the shaft 10 then continues to rotate, the cams 16, 11 and 9 will cause the rams 17, 12 and 6 to be withdrawn successively from their uppermost position, shown in Figure 2, to the position of Figure 1, releasing the upset portion of the flange and permitting the plate 4 and the sheet 3 to be moved laterally on the table 2 to permit the next edge

portion of the sheet 3 to be flanged and upset in the manner just described.

In the embodiment of Figures 4 to 6, there is provided an upper die or reciprocating element 40 and a lower fixed die element 41.

The element 40 is provided with a contact plate 44 upon its lower face which serves for holding down the sheet metal 3, the edge of which is to be flanged, which sheet metal 3 is carried by the support plate 4.

The plate 4 carries a guiding pin 42 projecting into a corresponding groove 43 of the lower die 41 and used for the guiding of the sheet 3 and the plate 4 upon the die element 41.

The pressure plate 44 is attached by the threaded pins 45 to the upper die 40. The pins 45 are encircled by coil springs 46 situated in recesses provided in the upper die 40. The enlarged head 47 of each pin 45 fits in a separate recess 48. When the die 40 is raised, the springs 46 maintain the plate 44 at a distance from the lower surface of the die 40. The heads 47 striking the bottom of the recesses 48 will limit the distance by which the pressure plate 44 may be moved away from the upper die 40 by the compression springs 46.

In a semi-circular recess in the upper die 40, as best shown in Figure 5, are positioned the jaws 50 and 51, the upper faces of which are circular so as closely to fit into the circular recess and to be movable therein.

The two jaws 50 and 51 are mounted upon the pivot pin 52 so that they may swing toward and away from each other. The pivot pin 52 is mounted on a plate 53 which is connected by screws 54 to the upper die member 40.

Those portions of the jaw members 50 and 51, which are situated below the pivot 52, project beyond the lower surface of the upper die 40. The jaw members 50 and 51 have extension portions 61 and 62 respectively, which are normally pressed apart by the spring 60 which spring is located below the pivot element 52. The extensions 61 and 62, as best shown in Figure 5, are received in the recesses having the bevelled faces 63 and 64 which tend to press the lower extensions 61 and 62 and the lower portions of the jaws 50 and 51 together against the action of the spring 60 upon lowering of the upper die element 40.

The lower die element 41 receives in a circular recess, an inside pair of upsetting jaws 55 and 56, the outside surfaces of which are of cylindrical shape. These jaws are shown in perspective removed from the assembly of Figure 5 in the lower part of Figure 6.

These jaws 55 and 56 are held in position by means of the plate 57 (see Figure 4).

The top surfaces of these jaws 55 and 56 are in the same plane as the top of the lower die element 41.

A compression spring 65, inserted between the jaws 55 and 56, tends to spread these jaws apart.

Those surfaces of the two pairs of jaws, which are situated opposite each other at the end of a pressure stroke, are roughened to provide a better grip on the metal sheet to be treated.

As shown best upon Figure 6, each of the jaws 55 and 56 is provided with an extension 66 and 67, respectively, which extensions are received between the lower extensions 61 and 62 of the jaws 50 and 51.

As a result, upon a lowering of the upper die element 40 and a movement of the extensions 61 and 62 toward each other along the bevel surfaces 63 and 64, the extensions 66 and 67 will be pressed together moving the lower portions of the jaws 55 and 56 together.

A stop pin 68 positioned in a recess in the upper die element 40, serves to center the jaws 50 and 51 after they have been returned to their initial position by the spring 60 after each stroke of the press.

In operation, when the die elements 40 and 41 move toward each other, after the sheet 3 has been placed upon the plate 4, as shown in Figure 4, the pressure plate 44 will first contact the sheet metal piece 3. The spring 46 will then be pressed until the plate 44 contacts the bottom of the upper die element 40, whereupon the jaws 50 and 51 will press down the projecting edge of the sheet metal 3 against the outside faces of the inside jaws 55 and 56. The bent edge of the sheet 3 will be brought between the opposed front surfaces of the two pairs of jaws 50, 51 and 55, 56.

At the same time, the lower bevel edge of the plate 53 attached to the upper die 40, will contact with the adjustable bevel surface 70 of a member carried by the lower die 41. This contact will tend to press the lower end of the plate 53 with the jaws 50 and 51 inwardly against the flanged edge portion of the sheet of metal 3.

As this occurs, the jaws 50 and 51 will press against the jaws 55 and 56 and at the same time, the jaws will tend to move together because of the downward sliding movement of the extensions 61 and 62 of the upper jaws 50 and 51 upon the bevel faces 63 and 64. Thus the pairs of jaws carry out oscillatory movements in opposite directions about the pivot 52. As shown in Figure 5, the extensions 61 and 62 of the upper jaws 50 and 51 engage the projections 66 and 67 of the lower jaws 55 and 56 and compel them to carry out the same oscillatory movements. The opposed ribbed front surfaces of the two pairs of jaws transmit this movement to the edge of the metal sheet 3 with the result that the flanged edge portion will be upset, giving the same effect as obtained already in the embodiment of Figures 1 to 3.

The bevel surface 70 is adjustable by means of the adjusting screw 68, so that the pressure may be regulated and the device may be adapted to different thicknesses of the sheet 3.

In the third alternative construction shown in Figures 7 and 8, a pair of upsetting tongs is provided which is more fully described in German Patent No. 500,811.

In this embodiment the sheet of metal 3 is clamped between the support plates 4 and 4'. Then, this combination is clamped between the supporting table 72 and the holding device 75 which is reciprocably mounted in the machine frame 73 and pressed down by an encircling coil spring 74.

This upper holder member 75 has a step 76 which contacts the inside edges of the upper support plate 4. The inside edge of the lower support plate 4' serves as the bending edge or as the pivot upon which the flanging takes place. The upsetting tongs are mounted upon the reciprocating structural element 77 which is provided with a guide 80 and which may be moved longitudinally in a direction of the plane of the edge of the sheet metal piece 3.

One leg 78 of the pair of tongs is rigidly mounted on the body 77 while the other leg 79 is pivotally mounted at 81. The two tong elements are normally separated by the intervening leaf spring 82 as long as pressure is not applied to the upper tong element 79.

The upper leg 79 is normally operated by the lever 83 which is pivotally mounted at 84 upon the structure 77 and has a projection 85 carrying a roller engaging the upper tong element 79 to press it against the lower fixed tong element 78.

As described in the German Patent No. 500,811, the two tong elements may enclose pairs of jaws engaging bevelled surfaces provided in the tong elements.

Upon movement of the arm 83 downward in the direction indicated by the arrow, the two tong elements 78 and 79 will firmly grasp the edge of the plate 3 to bend said plate around the edge of the lower support plate 4' and also will compress and draw together such bent edge so as to produce the upsetting action in a direction perpendicular to the plane in which the tong elements move.

As indicated in Figures 7 and 8, when the lever 83 is moved downwardly from the position of Figure 7 to the position of Figure 8, the support element 80 is guided in its movement by the swinging linkage arrangement 84, 85, 86, 87 which is connected to the machine frame 73 and forms a parallelogram. Thus the element 80 swings about the bent edge of the sheet 3 so as to give proper movement to the tong elements 78 and 79.

It will be noted that the swinging bars 84 and 86 are mounted upon the machine frame 73 by the pivotal connections 88 and 89, the line connecting the axes of the pivot mounts 88 and 89 extending through the bending edge of the sheet of metal 3.

As the support element 80 is moved downwardly by the lever 83 in the direction indicated by the arrow in Figure 7, it extends a spring 90 which is connected to the joint between the links 85 and 86 by the pin 91 and to the frame 73 by the pin 92. The spring 90 tends to move these parts in a position in which the structure 77 is in engagement with the stop 93, so that the upward movement of the structure 77 is limited by the upper stop pin 93, while the outward movement of the lever 83 is limited by the stop pin 93'. The lever 83 not only starts the swinging movement but is also used to actuate the tongs 78 and 79.

The downward movement of the structure 77—80 is limited by the adjustable stop pin 99 which may be placed in the various openings 98, depending upon the angular flange which it is desired to obtain. The stop pin 99 is used to determine the angle of bending and also serves as a support for the body 77, so that when the bending of the metal edge is completed and the body 77 rests against the pin 99, high compression forces are transmitted by the lever 83 to the pair of tongs 78, 79.

After the flanging, the position of the support plates 4 and 4' together with the intervening sheet metal piece 3 to be flanged, may be shifted by the foot pedal 96 which is connected by the rod 97 to the lever 95 which reacts against the enlargement 89' on the presser element 75 to elevate said presser element against the force of the spring 74.

The body 77 must be so adjusted prior to operation that the edge of the plate 3 is situated between the tong elements 79 and 78.

Then the presser element 75 is released by the foot pedal 96 and the presser foot 75 is permitted to move down so that its projection 76 will contact the edge of the plate 4.

Then, the lever 83 is moved downwardly in the direction of the arrow (see Figure 7). This downward movement will cause the jaws of the tong elements 78 and 79 to grasp the projecting edge of the sheet metal plate 3 following which the structure 80 will swing out together with the structure 77, as the lever 83 is moved downwardly.

Continued movement of the lever 83 will bend the edge of the sheet metal 3 from the position of Figure 7 to the position of Figure 8, until the guide structure 80 contacts the adjustable pin 99. Any additional force at this point upon the lever 83 will press together the flanged edge of the plate 3 accomplishing the result already described in connection with the embodiments of Figures 1 to 6.

After termination of the bending and upsetting operations, the hand lever 83 may then be elevated until the stops 93 and 93' will limit further upward movement.

At this point, the spring 82 will open the tong elements 78 and 79 and the elements 78 and 79 may be moved outwardly along with the structure element 77 which slides in the guide element 80.

The spring 90 during this operation effects return of the entire swinging mechanism until the structural portion 77 strikes the pin 93.

Then, to move the edge of the sheet 3 to the next position to be flanged, the foot lever 96 is pressed down releasing the presser element 75 and permitting movement of the sheet 3 to the next position. The operation may then be repeated, the jaws engaging that portion of the sheet 3 which is adjacent to the one treated.

It is apparent that the specific illustrations shown above have been given by way of illustration and not by way of limitation and that the structures above described are subject to wide variation and modification without departing from the scope or intent of the invention, all of which variations and modifications are to be included within the scope of the present invention.

What is claimed is:

1. An apparatus for working sheet metal comprising two die elements movable relatively to each other to clamp a sheet of metal and to bend an edge portion thereof, each of said die elements comprising jaws, means connected with said jaws for causing them to operate as an upsetting tool and upset the bent portion of the metal sheet, and means connected with the first-mentioned means to actuate the first-mentioned means close to the end of the clamping movement of the die elements.

2. An apparatus for working sheet metal comprising two die elements movable relatively to each other to clamp a sheet of metal and to bend an edge portion thereof, each of said die elements comprising a pair of jaws, and means connected with said jaws for causing the jaws of each pair to move relatively to each other in the direction of said edge portion and to move toward each other close to the end of the clamping movement of the die elements, thereby upsetting the bent portion of the metal sheet.

3. An apparatus for working sheet metal comprising two die elements movable relatively to each other to clamp a sheet of metal and to bend an edge portion thereof, each of said die elements comprising a pair of jaws, each of said jaws being substantially flat and having substantially the form of a cylindrical sector having a front surface adapted to engage the metal sheet, the front surfaces of two jaws constituting a pair being situated one opposite the other, pivots carried by the die elements and rotatably

supporting said jaws, and means engaging said jaws to cause them to operate as an upsetting tool and upset the bent portion of the metal sheet.

4. An apparatus for working sheet metal comprising a pair of tongs, a structural element carrying said pair of tongs, a guide supporting said structural element, said structural element being movable along said guide, said pair of tongs being adapted to clamp an edge portion of a sheet of metal, means supporting said sheet of metal and comprising a bending edge, and means connected with said guide for causing said guide, said structural element and said pair of tongs to swing about said bending edge to cause said pair of tongs clamping said edge portion of the sheet of metal to bend it over said bending edge and to upset it.

5. An apparatus for working sheet metal comprising a pair of tongs, a structural element carrying said pair of tongs, a guide supporting said structural element, said structural element being movable along said guide, said pair of tongs being adapted to clamp an edge portion of a sheet of metal, means supporting said sheet of metal and comprising a bending edge, a lever pivotally supported by said structural element and having a member engaging said pair of tongs and causing said pair of tongs to clamp said edge portion of the sheet of metal, a leverage system connected with said guide and causing said guide, said structural element and said pair of tongs to swing about said bending edge to cause said pair of tongs clamping said edge portion of the sheet of metal to bend it over said bending edge upon the further actuation of said lever, and a stop limiting the swinging movement of said guide, said structural element and said pair of tongs, a further pressure against said lever after the completion of said swinging movement being transmitted to said pair of tongs and causing an upsetting of the bent portion of the metal sheet to eliminate folding thereof.

6. An apparatus for edging sheet metal of irregular and curved outlines, said apparatus comprising, in combination with an upsetting tool for upsetting a bent edge of a metal sheet to eliminate folding thereof, single means supporting said tool and engaging said edge to bend the same, and means connected with said supporting and bending means for moving the same to bend said edge and simultaneously move said upsetting tool into an operative position in engagement with said edge.

7. An apparatus for edging sheet metal of irregular and curved outlines, said apparatus comprising, in combination with an upsetting tool for upsetting a bent edge of a metal sheet, single movable means supporting said tool and engaging said edge to bend the same, said means being movable to bend said edge and simultaneously move said upsetting tool into an operative position in engagement with said edge, and driving means moving said supporting and bending means and actuating said upsetting tool for upsetting said bent edge to eliminate folding thereof.

8. An apparatus for edging sheet metal of irregular and curved outlines, said apparatus comprising, in combination with an upsetting tool for upsetting a bent edge of a metal sheet to eliminate folding thereof, a supporting table having a bending edge, a holder member movable perpendicularly to the supporting surface of the supporting table, a spring pressing said holder member against the metal sheet lying upon said supporting surface to clamp said sheet, single movable means supporting said tool and engaging said edge to bend the same, said means being movable to bend said edge and simultaneously move said upsetting tool into an operative position in engagement with said edge, and driving means moving said supporting and bending means and raising said holder member from said metal sheet after the bending and upsetting of said edge thereof.

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