

Dec. 24, 1935.

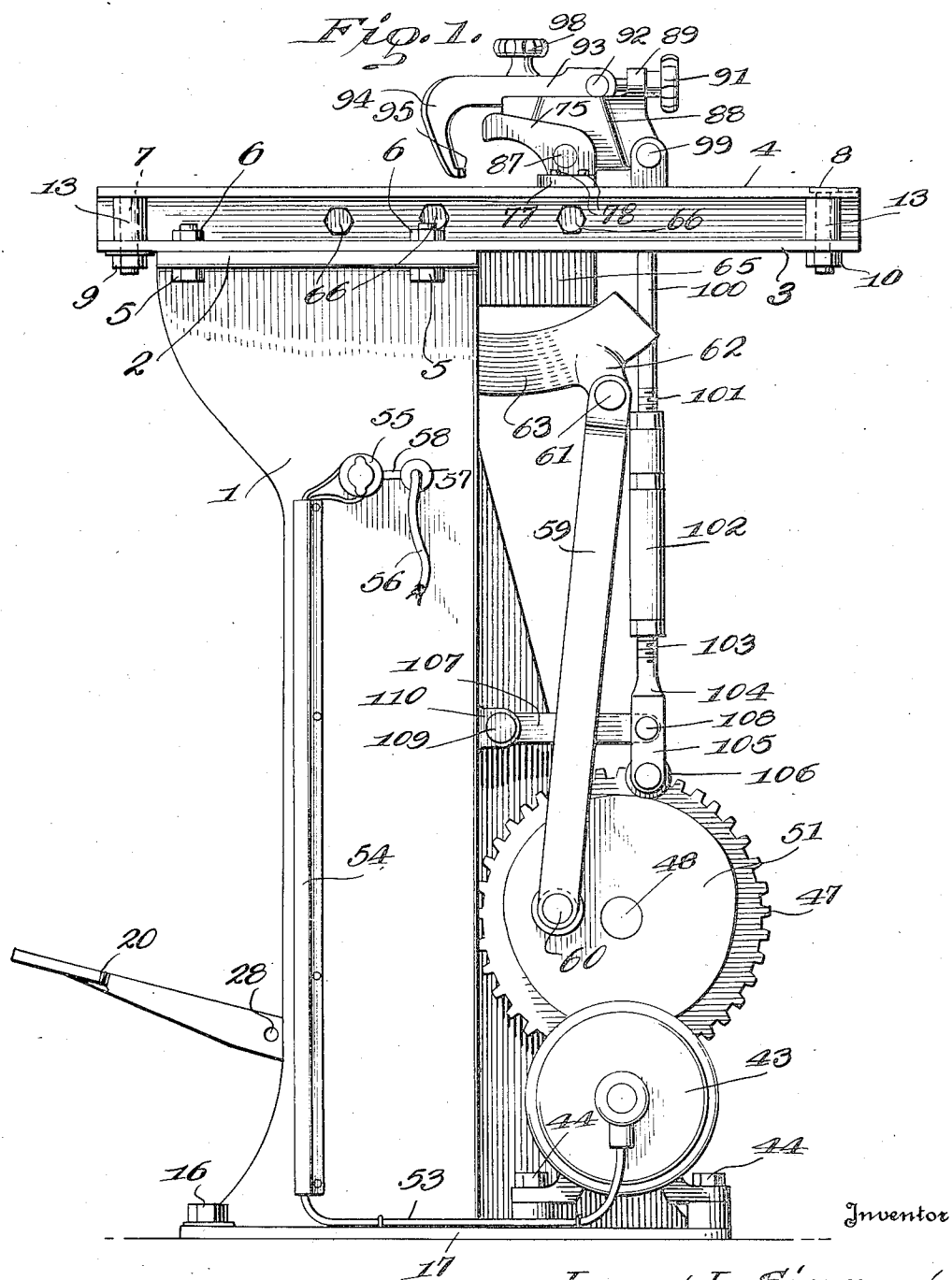
J. L. SIMMONS

2,025,360

## SHEET METAL FORMING MACHINE

Filed Jan. 6, 1932

5 Sheets-Sheet 1



Inventor

*James L. Simmons*

By *Milana & Milana*  
Attorneys

Uttörneye

Dec. 24, 1935.

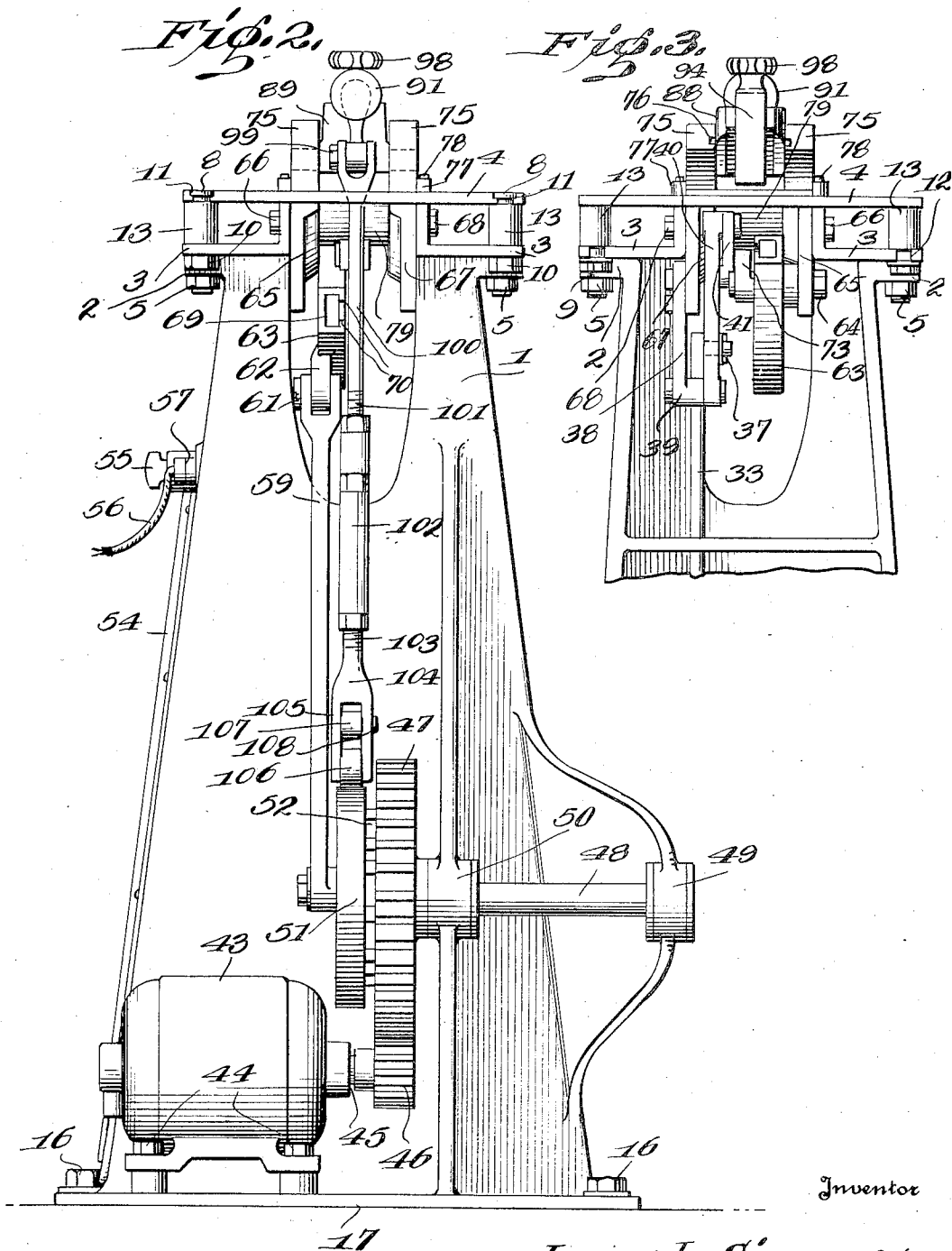
J. L. SIMMONS

2,025,360

SHEET METAL FORMING MACHINE

Filed Jan. 6, 1932

5 Sheets-Sheet 2



Inventor

James L. Simmons

334

Milano & Milano  
Attorneys



Dec. 24, 1935.

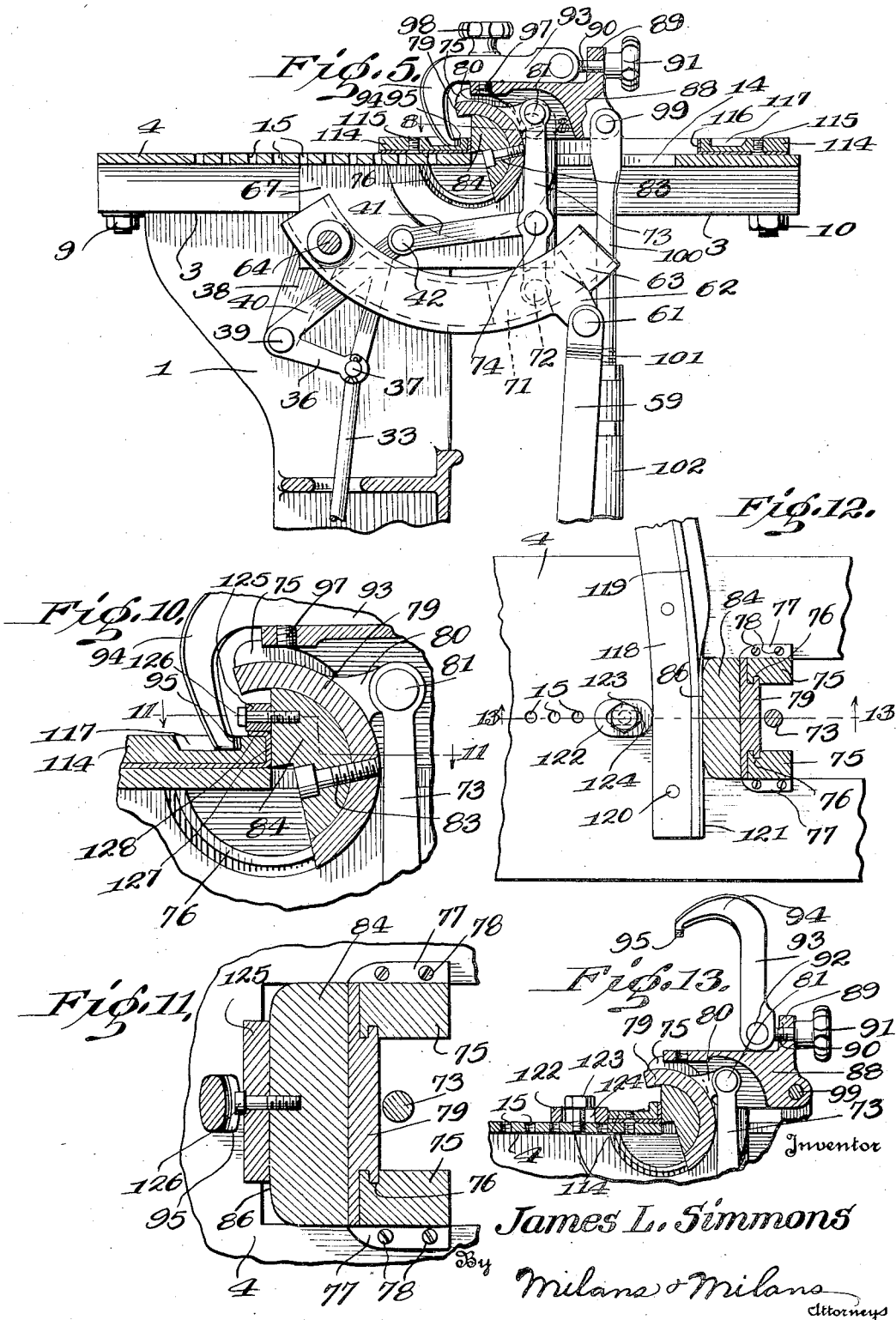
J. L. SIMMONS

2,025,360

SHEET METAL FORMING MACHINE

Filed Jan. 6, 1932

5 Sheets-Sheet 4



Dec. 24, 1935.

J. L. SIMMONS

2,025,360

SHEET METAL FORMING MACHINE

Filed Jan. 6, 1932

5 Sheets-Sheet 5

*Fig. 6.*

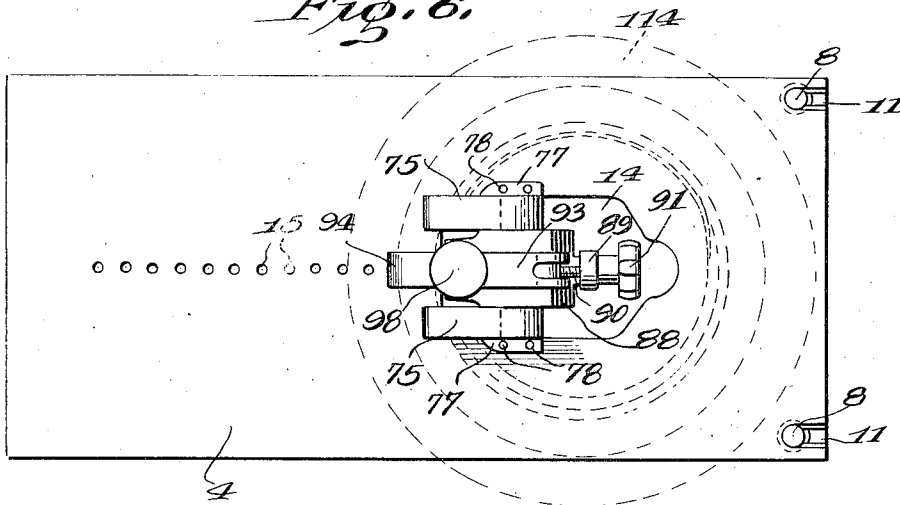


*Fig. 7.*

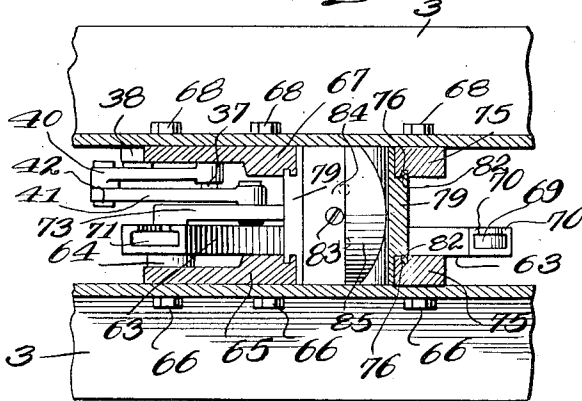


*Fig. 8.*

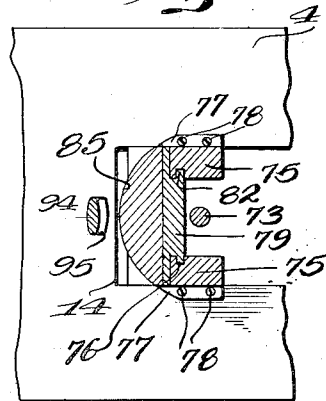
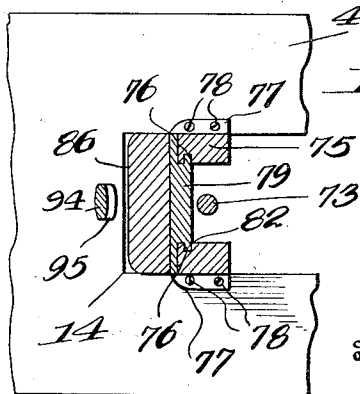


*Fig. 9.*



## UNITED STATES PATENT OFFICE

2,025,360

## SHEET METAL FORMING MACHINE

James Lee Simmons, Colmar Manor, Md., assignor to The Engineering and Research Corporation, a corporation of the District of Columbia

Application January 6, 1932, Serial No. 585,067

17 Claims. (Cl. 153—16)

My invention relates to new and useful improvements in a machine for forming sheet metal and more particularly to a machine of this character for forming flanges on sheet metal adapted more particularly for use in aircraft construction.

The principal object is the provision of a machine of the character described adapted to eliminate the use of dies which are of excessive cost and to replace skilled hand labor which is slow and expensive.

Another object of the invention resides in the provision of a forming machine including a hammer or forming member for turning a flange on the edge of sheet metal while the metal is moved relative to the hammer or forming member by the hands of the operator or mechanically.

Still another object of the invention consists in the provision of a machine of the character described having a clamping member synchronized with the hammer whereby the material is clamped and held as the hammer or forming member turns the flange.

As further objects I provide in a machine of the character described means whereby the throw of the hammer or forming member may be adjusted and means whereby either a single or double flange may be turned.

With the above and other objects in view which will appear as the description proceeds, my invention consists in the novel details of construction and arrangement of parts, described in the following specification and illustrated in the accompanying drawings, and while I have illustrated and described the preferred embodiments of the invention, as they now appear to me, it will be understood that such changes may be made as will fall within the scope of the appended claims.

In the drawings:—

Fig. 1 is a side elevation.

Fig. 2 is a rear elevation.

Fig. 3 is a fragmental front elevation.

Fig. 4 is a longitudinal vertical section through the machine with parts shown in side elevation and the hammer or forming member shown in lowered position.

Fig. 5 is a fragmental longitudinal vertical section, similar to the showing in Fig. 4, with parts shown in elevation, and the hammer or forming member shown in raised position.

Fig. 6 is a top plan.

Fig. 7 is a horizontal section on the line 7—7 of Fig. 4 looking in the direction of the arrows.

Fig. 8 is a section on the line 8—8 of Fig. 5 looking in the direction of the arrows.

Fig. 9 is a view similar to Fig. 8 showing a slightly different form of hammer or forming member.

Fig. 10 is a fragmental vertical section through a hammer or forming member for forming a double flange with parts shown in side elevation.

Fig. 11 is a horizontal section on the line 11—11 of Fig. 10 looking in the direction of the arrows.

Fig. 12 is a section similar to Fig. 8 showing the use of a guide member in place on a clamping member; and

Fig. 13 is a vertical section on the line 13—13 of Fig. 12.

One of the main objections to the use of sheet metal construction in aircraft has been the cost of fabrication, and the relatively small production of the industry renders the use of dies somewhat prohibitive in cost while handwork is slow and expensive. To overcome the above objections the present machine has been developed to overcome the necessity of hand labor until the industry has become so large and prosperous that the use of dies will be justified. My machine will turn up an internal flange, an external flange, or a double flange and, as illustrations of the work which may be done with the machine I might refer to the formation of wing ribs, control surface ribs, longitudinals, frames and bulk heads for monocoque fuselages or pontoons, tank ends and bulkheads or the like. Of course, my machine is not limited for forming the mentioned articles but may be used wherever it is desired to turn up a flange from sheet metal.

In the drawings 1 indicates a pedestal or stand provided at the top with the out-turned flanges 2 to which are secured a table or platform including the angle iron side strips 3 and top plate 4. The angle iron strips 3 are secured to the flanges 2 by means of the bolts 5 and nuts 6 whereas the top plate 4 is secured to the angle iron strips 3 by means of the bolts 7 and 8 and the nuts 9 and 10. The top plate 4 is provided, at its rear end, with the notches 11 which receive the heads of the bolts 8, as shown more particularly in Figs. 1 and 6 of the drawings and each of the angle iron strips 3 is provided in its forward edge with a notch 12 to receive the bolts 7. Sleeves 13 are received around the bolts 7 and 8 and between the under surface of the plate 4 and the top surfaces of the angle iron strips 3. With the construction described the plate 4 may be detached from the angle iron strips 3 by a sliding movement, towards the front of the machine, when the nuts 9 and 10 are loosened and the angle iron strips 3 may be disengaged from the pedestal 1 by removing the nuts 6 from the bolts 5.

The plate 4 is provided with the relatively large opening 14, and the series of relatively small openings or perforations 15, as shown more particularly in Fig. 6 of the drawings, for a purpose which will be later brought out. The pedestal 1 will be secured to the floor or other support by means of the bolt 16, or other suitable fastenings, which pass through the base 17, as shown.

Secured to the front face of the pedestal 1, by means of the bolts 18 or other suitable fastenings, is a bracket 19 to which a foot treadle 20 is pivotally connected at 21. This foot treadle has an upwardly extending arm 22 provided adjacent the top with a threaded opening in which operates the adjusting screw 23, the inner end of the adjusting screw normally engaging the bracket 19 as shown more particularly in Fig. 4 of the drawings. A lock nut 24 is received on the adjusting screw 23 for holding the same in its adjusted positions. The foot treadle is normally held in its raised position by means of the coiled spring 25, the upper end of the coiled spring being secured to the pedestal by means of a bolt 26 or other suitable fastening and the lower end of the spring being formed with a hook 27 to be received in one of the longitudinally spaced perforations 28. As stated, this spring 25 normally holds the treadle in its raised position with the inner end of the adjusting screw 23 engaging the face of the bracket 19. Also secured to the treadle 20 by means of the transversely extending pin 29 is the lower end of a rod 30, the upper end of the rod being provided with an interiorly threaded sleeve or socket 31 to receive the threaded end 32 of a rod 33. A lock nut 34 is received on the threaded end 22 of the rod 33 and engages the end of the socket or sleeve portion 31, as shown more particularly in Fig. 4 of the drawings. The rod 33 may be adjusted relative to the rod 30 by turning the threaded end 32 in the socket or sleeve portion 31 and when the proper adjustment is secured it may be held by the lock nut 34. The transversely extending pin 29 is held in position by means of a cotter key 35. The upper end of the rod 33 is secured to the arm 36 of a bell crank lever by means of the pin 37, the bell crank lever being pivotally connected to the bracket 38 at 39. The other arm 40 of the bell crank lever normally extends upwardly and has the link 41 pivotally connected thereto at 42.

An electric motor 43 is secured to the base 17 of the pedestal 1 by means of the bolts 44 or other suitable fastenings and secured to the end of the motor shaft 45 is a gear or pinion 46 which meshes with the relatively larger gear 47 carried by the inner end of the horizontal shaft 48 supported in the bearings 49 and 50. Secured to one face of the gear 47 is a cam disc or plate 51, a spacer member 52 being positioned between the face of the gear and the face of the cam disc or plate 51, as shown more particularly in Fig. 2 of the drawings.

Current is supplied to the motor 43 through the wire 53 which passes through the guide or housing 54 secured to the pedestal 1, as shown more particularly in Figs. 1 and 2 of the drawings, and is connected to the switch indicated at 55. The lead in conductor wire, shown at 56, is plugged into the socket 57 secured to the pedestal and a wire 58 connects the socket to the switch 55.

The lower end of a bar or link 59 is pivotally connected to the outer face of the cam disc or plate 51, eccentrically at 60 and the upper end of

the bar or link is pivotally connected at 61 to the depending lug 62 formed adjacent one end of the arcuate-shaped guide or arm 63. The guide or arm 63 is pivotally connected at 64 to the plate 65 which is secured to one of the angle iron side plates 3 of the table or platform by means of the screws 66 or other suitable fastenings. A similar plate 67 is secured to the opposite angle iron strip 3 by means of the screws 68 or similar fastenings, the inner faces of these plates being spaced as shown more particularly in Figs. 2 and 7 of the drawings. The arcuate-shaped guide or arm 63 is provided in its inner face with the recess 69 the outer portion of which is restricted by means of the inwardly directed flanges 70 as shown more particularly in Figs. 2, 3 and 7 of the drawings. Received and slidable within the recess 69 of the guide or arm 68 is a block 71 to which is pivotally connected at 72 one end of a link 73. The inner end of the link 41, which has its outer end pivotally connected at 42 to the arm 40 of the bell crank lever, is pivotally connected at 74 to the link 73 intermediate the ends thereof as shown more particularly in Figs. 4 and 5 of the drawings.

Each of the plates 65 and 67 is provided at one end of its upper edge with an inwardly directed arcuate-shaped overhanging portion 75 and formed in the inner face of each of the plates is a recess 76 which extends into the arcuate-shaped overhanging portion 75 as shown more particularly in Fig. 4 of the drawings. An outwardly directed flange 77 is formed on each of the upwardly extending portions 75 of the plates 65 and 67 and overlies the upper surface of the plate 4, forming the top of the machine, and screws 78 or other suitable fasteners pass through these flanges and engage in threaded openings of the plate as shown more particularly in Figs. 6, 8, 9, 12 and 11 of the drawings.

Mounted between the plates 65 and 67, and adapted for oscillating or pivotal movement, is an arcuate-shaped member 79 which has an outwardly directed lug 80 to which the end of the link 73 is pivotally connected at 81. The member 79 has the outwardly directed flanges 82 which are received and operate in the recesses 76 formed in the inner faces of the plates 65 and 67 and extending into the arcuate-shaped overhanging portions 75 thereof. Detachably connected to the member 79 within the concaved face thereof, by the screws 83 or other suitable fastenings is a hammer plate 84 which may be of various shapes. In the construction shown in Figs. 4, 5, 7 and 8 this hammer plate is provided with a curved outer face or edge 85 for forming a curved flange around an opening while in Figs. 9, 12 and 13 I have shown a hammer plate having a straight outer face or edge 86 for forming a straight flange along the edge of a strip of material or a flange having a relatively slight curve.

Pivotally connected at 87, between the upstanding portions 75 of the plates 65 and 67 is a clamp carrying member 88 having the upwardly extending lug 89 through which the threaded rod 90 extends, as shown more particularly in Fig. 4 of the drawings, this threaded rod having on its outer end a knob 91 by which it may be rotated. The threaded end of the rod 90 extends into and through a threaded opening in a transversely extending pin or rod 92 to which is pivotally connected a clamping member 93 having the depending hook portion 94 the lower end of which is intuned as shown at 95 to provide a flat under

surface for engaging the work carrying member to be later described. The clamp is provided with an elongated opening 96 to receive the screw 97 having the knob portion 98 on its outer end. The screw engages in a threaded opening in the clamp carrying member 88, as shown more particularly in Fig. 4 of the drawings. When the screw 97 is released from the threaded opening the clamp may be swung upwardly on the pivot pin 92, to the position shown in Fig. 13, and when the screw is merely loosened the clamp may be adjusted by means of the screw 90, the elongated opening 96 permitting movement of the clamp relative to the carrying member 88 and the screw 97. Pivotally connected to the clamp carrying member 88 at 99 is the upper end of the rod 100 having its lower end 101 threaded and received within the sleeve 102. Received in the opposite end of the sleeve 102 is the threaded end 103 of the rod 104 having the forked end 105 in which is mounted the roller 106, this roller normally engaging the edge of the cam plate or disc 51. A link 107 is pivotally connected at 108 to the forked member 105 and its opposite end is pivotally connected at 109 to the lug 110 projecting from the pedestal 1. A coiled spring 111 has one end engaged in an opening 112 formed in the link 107 and its opposite end connected to a pin 113 carried by the pedestal 1. This coiled spring 111 normally draws the outer end of the link 107 downwardly and holds the roller 106 in engagement with the edge of the cam disc or plate 51.

The sheet or strip of metal to be flanged will be connected to a form or workholder. In Figs. 4, 5 and 6 of the drawings I have shown a form for carrying the material when a flange is to be formed around an opening in the material. In these figures the form or workholder is shown at 114, of ring-shape, and the strip of material is secured thereto by means of the screws 115. The formed flange is shown at 116 and a recess 117 will be formed in the upper surface of the form to receive the clamp as shown more particularly in Figs. 4 and 5 of the drawings. In Figs. 12 and 13 I have shown a form 118 having an upwardly extending flange 119 along one edge and a relatively narrow strip of material is secured to this form by means of the screws 120 or other suitable fastenings. With form shown in Figs. 12 and 13 a relatively straight flange 121 will be formed along the edge of the material or a flange may be formed having a relatively slight curve. If desired, when using a form such as is shown in Figs. 12 and 13 the clamp 93 may be raised into inoperative position and a guide member or plate 122 may be secured to the top plate 4 of the table by means of the screw 123 or similar fastening. The guide member or plate 122 will be provided with the elongated opening 124 so that the same may be adjusted relative to the screw 123 or relative to the strip carrying form. It will be understood that the screw 123 may be engaged in any one of the openings 15 formed in the top plate 4.

In Figs. 10 and 11 of the drawings I have shown means whereby a double flange may be formed. For doing this a block or strip 125 is secured to the hammer plate 84 by means of the screw 126 or other suitable fastening. In this form of the invention the hammer plate will form the upwardly extending flange 127 on the edge of the material whereas the block or strip 125 will form the horizontally extending flange 128.

From the above detail description it is thought that the construction of my machine will be clearly understood and I will now endeavor to more clearly bring out the operation. The machine will turn up an internal flange on a  $3\frac{1}{2}$  inch radius and an external flange on a 1 inch radius. It will also turn a double flange as shown more particularly in Fig. 10 of the drawings. The size of the piece of material being operated on is immaterial. A form will be made corresponding to the shape of the part to be formed from the sheet metal strip. In the drawings I have illustrated the manner in which an internal flange may be turned up from a ring-like piece of material, the manner in which a flange may be turned up from a straight strip of material or a strip having a relatively small curve, and the manner in which a double flange may be turned either on a circular strip of material or a straight strip. The machine, however, is not limited to the particular shape shown and, as stated, the desired shape or form may be provided, the metal to be worked upon secured thereto, and the flange of the desired shape turned up. In order to provide for different shapes of flanges the hammer plate is detachably connected to the oscillating carrier member and hammer plates having different shaped edges may be provided at will. I have also found, in actual practice, that markings on the material may be eliminated by attaching a strip of paper or similar material to the material being operated upon and as the hammer plate engages the paper to turn up the flange no markings will be left upon the finished article. In setting forth the operation we might refer more particularly to Fig. 4 of the drawings where the parts are shown in their normal positions for operation on a ring-like strip of material for turning up the flange shown at 116 around an opening formed in the material. The material to be operated upon is secured to the form 114 by the screws 115 and it will be understood that originally the edge of the material, which forms the flange 116, will project inwardly or beyond the edge of the opening in the form when the electric motor is started by turning the switch 55 the gear 47 will be rotated through means of the gear 46 and this in turn will operate the cam disc or plate 15. As the block 71, in the recess within the guide or arm 63, is positioned so that the link 73 is on a line with the pivot point 64 of the guide or arm no movement will be imparted to the hammer member and carrier therefor. However, the clamp carrying member 88 will be swung on its pivot, with its clamp, through means of the roller 106 riding on the edge of the cam plate or disc 51. This will cause the lower end of the clamp, or the hook portion thereof, to be engaged within the recess 117 of the form 114 and securely clamp the form upon the table or top of the machine. In order to turn the flange upwardly the operator depresses the outer end of the foot treadle 20 and this pulls down on the rods 30 and 33 and swings the arms 40 of the bell crank lever inwardly and through means of the link 41 connected to the link 73 the block 71 will be slid in the guide or arm 63 to a point beyond the pivot point 64 for the arm or guide. The point to which the block is moved relative to the arm or lever 63 regulates the throw of the hammer plate carrier and when the block is moved, to its limit of movement, or to the position shown in Fig. 5 the greatest possible throw will be given to the hammer carrying member and hammer to complete the upturn of

the flange. It can be appreciated that in starting to turn the flange it will be best not to turn it completely at one contact of the hammer plate and to give a gradual turn. The block 71 should be moved gradually from the point shown in Fig. 4 to the point shown in Fig. 5. The clamping member is operated simultaneously with the hammer plate so that when the hammer contacts with the material being worked upon the form and material will be held tight against movement. The form may be moved by the hand of the operator or by any suitable form of power feed to the desired positions and properly guided or may be guided by the guide member 122 shown more particularly in Figs. 12 and 13 of the drawings. When using the guide member 122 the clamp 23 may, if desired, be made inoperative by raising into the position shown in Fig. 13. The clamp may be raised into the position shown in Fig. 13 by removing the screw 97 and swinging the clamp upon its pivot. As previously stated a double flange may be formed by adding the extra strip or block 125 shown more particularly in Figs. 10 and 11 of the drawings. When the foot is released from the foot treadle 20 the parts will be returned to their initial position by means of the coiled spring 25. I wish to lay particular stress on the fact that I have provided a machine which eliminates the ordinary hand hammering process and a machine which does not require expensive dies. The desired forms may be cheaply made and then by regulating the throw of the hammer the flange may be turned upwardly and engaged with the edge of the form.

While I have illustrated and described the machine as being operated by the motor 43 it will be appreciated that it might be operated by foot power or other suitable means and while I have illustrated and described the use of a form in turning the flange it will be understood that when desired and found practicable the use of the form may be eliminated. Also where I have shown the member 79 carrying the hammer plate 84 as being mounted for oscillating movement the member might be hinged for swinging movement to engage the hammer plate with the edge of the metal. When so hinged any suitable means and connections might be employed for operating the same.

Having fully described my invention what I claim as new and desire to secure by Letters Patent is:—

1. A machine of the character described including a support for the material to be operated upon, a member pivotally connected to the support, a clamping element adjustably connected to the pivoted member and adapted for swinging movement, means for operating the pivoted member to engage the clamping element to hold the material upon the support, and means engageable with the material for forming a flange thereon.

2. A machine of the character described including a support for the material to be operated upon, a bending element adapted to be engaged with the material to form a flange thereon, an arcuate-shaped arm pivotally connected to the support and having a recess in one face thereof, means for operating the arm, a member slidably mounted in the recess of the arm, means connecting said slidable member and bending element, and means for sliding the member in the recess of the arm for adjusting the throw of the bending element.

3. A machine for forming a flange on a piece of material including a support, a form free of connection to the support and adapted to be moved freely over the face thereof with the material positioned between the support and form, and a member adapted to be engaged with the material to bend a portion of the same against an edge of the form to provide the flange.

4. A machine for forming a flange on a piece of material including a support, a form of selected dimensions and shape free of connection to the support and adapted to be moved freely over the face thereof with the material positioned between the support and form, and a member adapted to be engaged with the material to bend a portion of the same against an edge of the form to provide a flange corresponding to the shape of the edge of the form.

5. A machine for forming a flange on a piece of material including a support, an impact receiving member having flange forming edges, said impact receiving member being free of connection to the support and adapted for movement freely over the face thereof with the material positioned between the support and member and one edge of the material projecting beyond the member, and a member adapted to be engaged with the projecting portion of the material to bend the same against an edge of the impact receiving member to provide the flange.

6. A machine for forming a flange on a piece of material including a support, a form to which the material is secured, said form being adapted for free movement over the support, and a member adapted to be engaged with the material to bend a portion of the same against an edge of the form to provide the flange.

7. A machine for forming a flange on a piece of material including a support, a form of selected dimensions and shape free of connection to the support and adapted to be moved freely over the support, means for securing the material to the form, and a member adapted to be engaged with the material to bend a portion of the same against the edge of the form to provide the flange.

8. A machine of the character described including a support for a metal article to be flanged, a hammer device to engage one edge of the article to upset the same, means for imparting rapid movements to the hammer device and to impart impacting blows on said edge, and means for adjusting the throw of said hammer device.

9. A machine of the character described including a support for a metal article to be flanged, a hammer device to engage one edge of the article to upset the same, means for imparting rapid movements to the hammer device and to impart impacting blows on said edge, and means for adjusting the throw of said hammer device during the continued operation of the machine.

10. A machine of the character described including a support for the material to be operated upon, a member adapted to turn a flange on the edge of the material, means for operating the member, and means for adjusting the throw of the member during continuous operation thereof.

11. A machine of the character described including a support for the material to be operated upon, a member adapted to turn a flange on the edge of the material, pivoted means for operating the member, and means adjustable relative to the pivot point of the first mentioned means to start the throw of the member.

12. A machine of the character described including a support for the material to be operated upon, a member adapted to turn a flange on the edge of the material, pivoted means for operating the member, and means adjustable relative to the pivot point of the first mentioned means to start the throw of the member and to adjust the throw during the continued operation of the machine.

13. A machine of the character described including a support for the material to be operated upon, a member pivotally connected to the support, a clamping member pivotally mounted and adjustably connected to the pivoted member, means for intermittently operating the pivoted member for engaging the clamping member with the material upon the support, a hammer device adapted to be engaged with the material to turn a flange thereon, and means for adjusting the throw of the hammer device.

14. A machine of the character described including a support for the material to be operated upon, a member pivotally connected to the support, a clamping member pivotally mounted and adjustably connected to the pivoted member, means for intermittently operating the pivoted member for engaging the clamping member with the material upon the support, a hammer device adapted to be engaged with the material to turn a flange thereon, and means for adjusting the throw of the hammer device during the continued operation of the machine.

15. A machine of the character described including a support for the material to be operated upon, a member adapted to turn a flange on the edge of the material, pivoted means for operating the member, means adjustable relative to the pivot point of the first mentioned means to start the throw of the member, and pedal control means to adjust the throw during the continued operation of the machine.

16. A machine of the character described including a support for the material to be operated upon, a bending element adapted to be engaged with the material to form a flange thereon, an arcuate-shaped arm pivotally connected to the support and having a recess in one face thereof, means for operating the arm, a member slidably mounted in the recess of the arm, means connecting said slidable member and bending element, and pedal controlled means for sliding the member in the recess of the arm for adjusting the throw of the bending element.

17. A machine of the character described including a support for the material to be operated upon, a member pivotally connected to the support, a clamping member pivotally mounted and adjustably connected to the pivoted member, means for intermittently operating the pivoted member for engaging the clamping member with the material upon the support, and a hammer device adapted to be engaged with the material to turn a flange thereon.

JAMES LEE SIMMONS.