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MACHINE FOR FORMING METAL PRODUCTS

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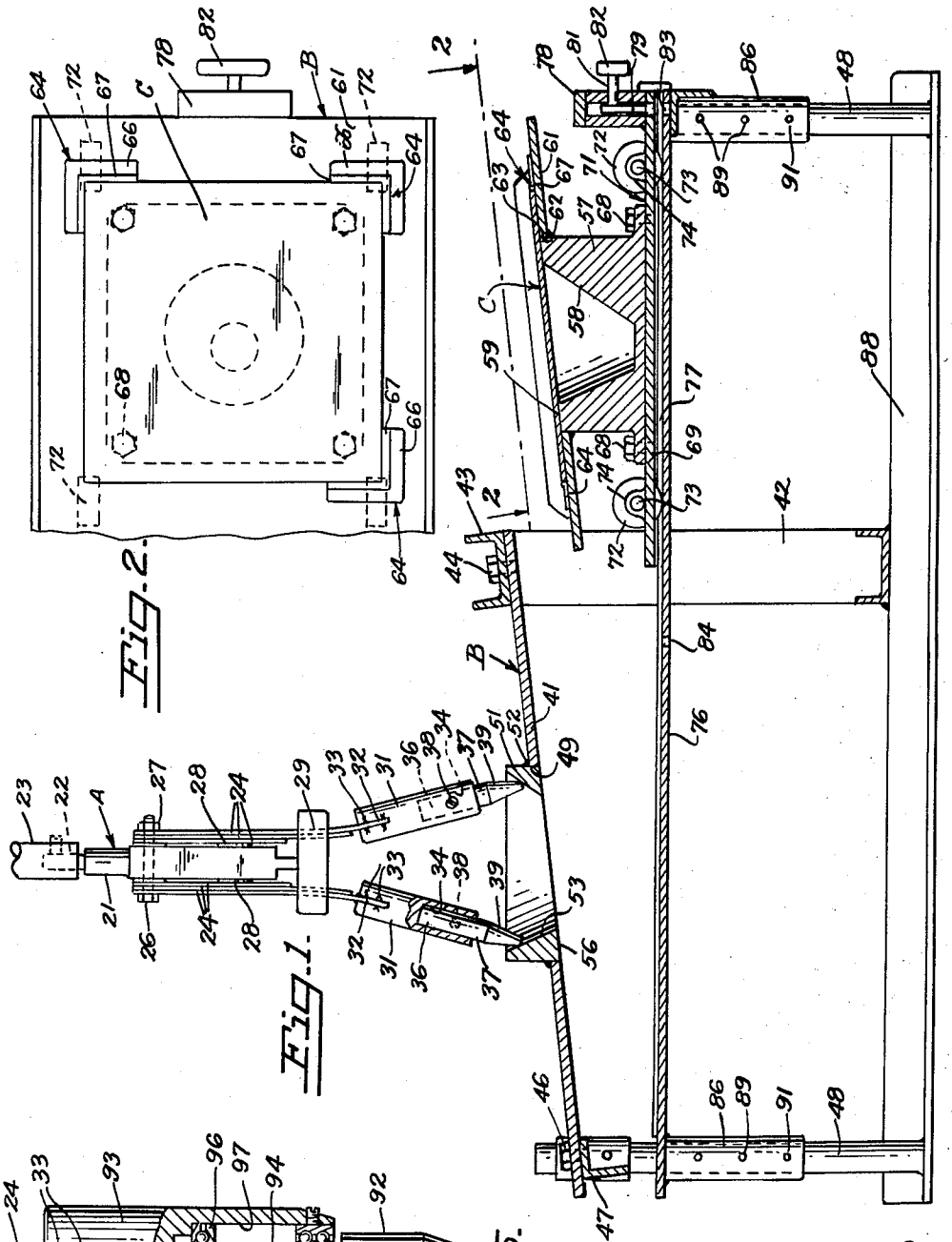


Fig. 2.

Fig. 1.

Fig. 5.

INVENTORS
JOHN W. WOODS
BY PERCY G. GRIBBLE
JOHN A. WARD

Townsend, Townsend and Hoppe
ATTORNEYS

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Fig. 3.

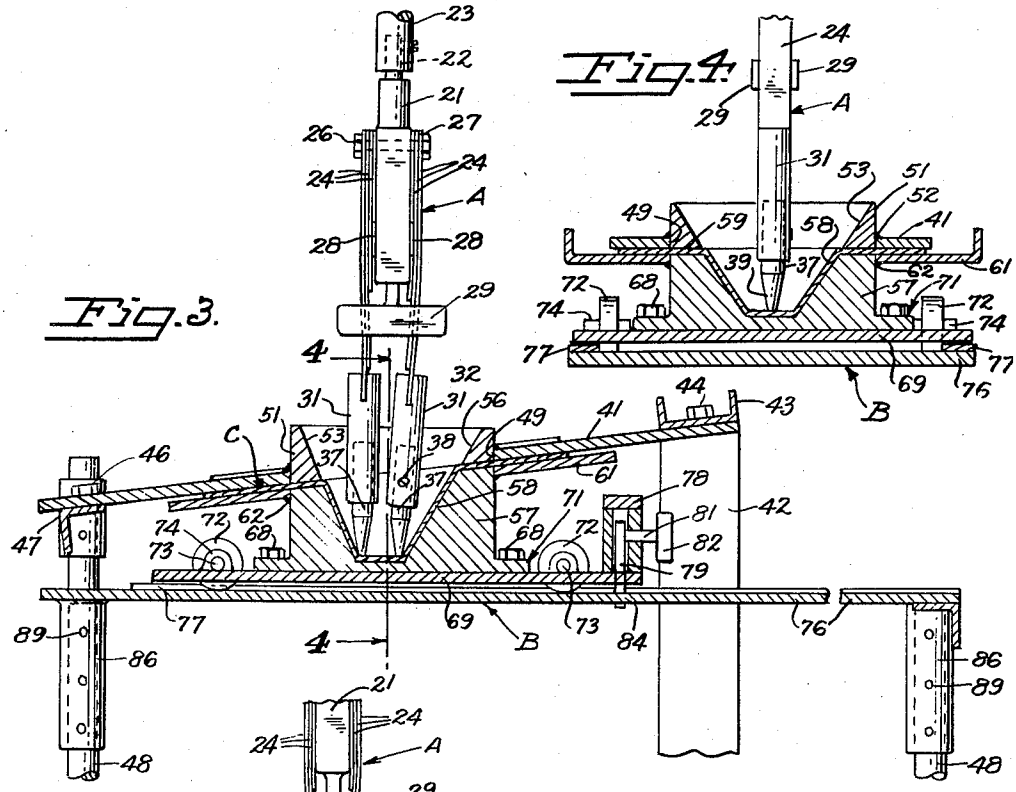


Fig. 4.

Fig. 6.

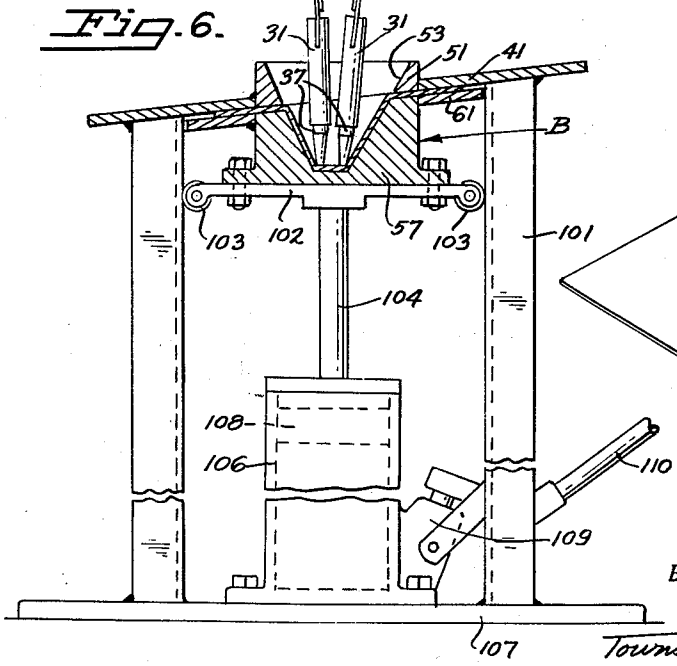
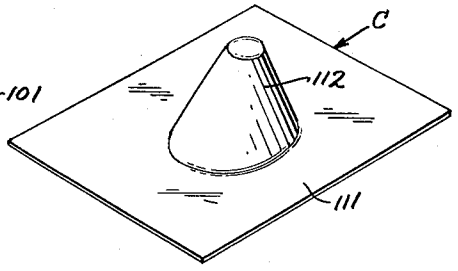


Fig. 7.



INVENTORS
JOHN W. WOODS
PERCY G. GRIBBLE
BY JOHN A. WARD

Townsend, Townsend and Hoppe
ATTORNEYS

United States Patent Office

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MACHINE FOR FORMING METAL PRODUCTS

John W. Woods, Percy G. Gribble, and John A. Ward, Auburn, Calif., assignors to Sierra Metal Products, Inc., Auburn, Calif., a corporation of Nevada

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11 Claims. (Cl. 113—52)

This invention relates to a new and improved apparatus and method of forming metal. More particularly the present invention relates to forming metal by a method of the same general class as spinning, but which is characterized by the fact that the tool rather than the workpiece revolves.

Conventional metal spinning involves the use of a hollow form which is attached to a lathe or similar revolving machine. A blank of metal is attached to the form and the machine started. The operator then presses a tool against the metal in such manner that the metal is stretched to form a projection which has the outline of the hollow die. Metal spinning has numerous advantages over other metal forming means, but also has certain inherent disadvantages which the present invention eliminates. Among the disadvantages is the fact that the tool must be moved toward and away from the die manually, thereby involving considerable labor cost. Another disadvantage of metal spinning is the fact that the lathe must be stopped to insert a new blank, which, by reason of the inertia of the machine, is time-consuming. Another disadvantage of the conventional spinning machine and method is the fact that the axis of rotation of the die must be perpendicular to the plane of the blank, which limits the versatility of use of spinning.

The present invention employs a stationary die upon which the metal blank is mounted. The tool is revolved and lowered so that the metal is stretched into the desired shape. Accordingly, the present invention has particular adaptation in the forming from flat blanks of metal seamless cones, particularly of the type used in roof flashings. One feature of the invention is the fact that the unstretched portion of the blank which surrounds the cone may be disposed at an angle to the cone. Accordingly the surrounding unstretched portion of the flashing may be disposed at the same angle as the pitch of the roof, while the cone is disposed vertically. This feature of the invention improves the construction of roof flashings. It will be understood, however, that the present invention has wide adaptation beyond the manufacture of roof flashings.

Accordingly a particular feature and advantage of the present invention is the fact that the tool, rather than the metal and die, spins. Thus the tool may remain spinning when a blank must be inserted or a completed workpiece removed. Accordingly the inertia of stopping and starting the blank is eliminated, improving the speed at which the machine can be operated.

Another feature of the invention is the fact that manual feeding of the tool is eliminated, so that automatic feeding and retraction of the tool relative to the die is possible.

Other objects of the present invention will become apparent upon reading the following specification and referring to the accompanying drawings in which similar characters of reference represent corresponding parts in each of the several views.

In the drawings:

Fig. 1 is a longitudinal vertical section of the machine showing the tool and die in one position of adjustment;

Fig. 2 is a fragmentary top plan view taken substantially along the line 2—2 of Fig. 1;

Fig. 3 is a view similar to Fig. 1 showing the tool and die in another position of adjustment;

Fig. 4 is a vertical sectional view taken substantially along the line 4—4 of Fig. 3;

Fig. 5 is a fragmentary view partially broken away in section of a modified tool and holder;

Fig. 6 is a longitudinal vertical sectional view showing a modified construction wherein the die moves vertically for loading; and

Fig. 7 is a perspective view of a device made in accordance with this invention.

The present invention comprises a rotatable tool portion A and a stationary work-holding portion B. The tool-holding portion comprises a stem 21 having a reduced diameter upper end 22 which fits inside and is held by a chuck 23. The chuck 23 is revolved in a manner similar to that by which a drill press chuck is revolved. Further, the chuck 23 is vertically reciprocated in substantially the same manner as a drill press may be. A plurality of leaf springs 24 is attached to the stem 21 by means of bolt 26 and nut 27. Wedge 28 attached to stem 21 between the stem and the undermost leaf 24 serves to hold the leaves diverging outwardly when in the position shown in Fig. 1. Stem 21 also carries a pair of guides 29 which insure that the springs 24 move radially outwardly and are not twisted out of radial alignment. The function of the springs 24 is to maintain the tool in such position that the blank is stretched to conform to the shape of the die, as hereinafter appears. The number, length and spacing of the springs 24 depends upon the nature of the operation being conducted. The force of the springs should be such as to shape the blank as desired, but not sufficient to rupture the blank.

Affixed to the lower end of one or more of the leaf springs 24 is a tool holder 31 having a slot 32 in its upper end which receives the lower end of one or more of the springs, the spring being held therein by a weld 33 or other suitable means. The lower end of tool holder 31 is formed with a cylindrical bore 34 and receives the reduced diameter upper end 36 of tool 37 therein, the tool being retained therein by set screw 38. Tool 37 may be formed of a fibrous material or plastic-impregnated nylon or other suitable material and has a tapered lower end 39 which is the working portion of the tool. When chuck 23 is caused to revolve, tools 37 are turned about the axis of stem 21. The force of springs 24 biases tools 37 outwardly.

The work-holding frame B is subject to considerable modification. In the form shown in Figs. 1–4, inclusive, there is provided a stationary top plate 41 supported at its front end by vertical channel-shaped legs 42 and an upper transverse support 43 to which the forward edge of the top plate 41 is attached by means of bolts 44. The rear edge of the top plate 41 is connected by means of bolts 46 to transverse angle 47 which is supported by rear legs 48, as hereinafter described. The center of the top plate 41 is formed with an aperture 49 in which fits tool guide 51 connected thereto by means of weld 52. The tool guide has a downwardly tapering internal bore 53. When the tool is at the upper limit of its movement, as shown in Fig. 1, the tool points 39 bear against the internal bore 53 and the latter prevents undue spreading apart and maintains the tools in position for subsequent forming of the metal. Accordingly, when the machine is in operation, the tool portion A is at no time raised above the position shown in Fig. 1.

It will be noted, as shown in Fig. 1, that the undersurface 56 of tool guide 51 and the top plate 41 may be disposed at an angle to the horizontal which conforms to the slope of a roof in which the flashing hereinafter described may be installed. The degree of the angle may be varied, depending upon the demands of the particular installation, or the top plate 41 and the bottom surface 56 may be horizontal, if desired.

Beneath the tool guide is a die block 57, the internal bore 58 of which comprises, in effect, a continuation of the bore 53 of the tool guide 51. The shape of the internal bore 58 determines the shape of the completed workpiece. It will be noted that the upper surface 59 of the die block 57 is at the same angle as the undersurface 56 of the tool guide 51 and of the top plate 41.

The die block 57 carries on its upper end a work-mounting plate 61 attached by means of weld 62 and having an aperture 63 for the upper end of the die block 57. At the commencement of the operation, the blank C is deposited on the work-mounting plate 61. In order to position the blank properly, corner-locating members 64 are attached to the work-mounting plate in such location that the corners of the blank C may be received therein. Each of the corner-locating pieces 64 comprises a base 66 which is angular in plan and has an upstanding inner edge 67, likewise angular in plan. As shown in Fig. 2, the blank C is positioned so that its corners fit against the edges 67. To facilitate installation of the blank, corner-locating pieces 64 may be positioned only at three of the four corners of the blank.

In order to move the die block 57 apart from the tool guide 51 and the work-mounting plate 61 from the top plate 41, various different structures may be employed. As shown in Figs. 1 and 3, the die block 57 is bolted by means of bolts 68 to a die-mounting 69 which is a portion of a horizontally sliding carriage 71. Carriage 71 comprises four rollers 72 attached to die-mounting 69 by means of pins 73 and hangers 74. A horizontally disposed guide 76 is attached to the frame B and supports carriage 71. Guide 76 is of extended length so that the carriage may be slid from a position underneath the tool, as shown in Fig. 2, to the retracted position shown in Fig. 1, at which position the blank is inserted and the completed workpiece is removed. Tracks 77 for rollers 72 mounted on guide 76 maintain the path of carriage 71 in proper alignment. Carriage 71 carries a latch body 78 in which is a latch 79 movable in a vertical plane. Latch shaft 81 is rotatably mounted in latch body 78 about a horizontal axis and has a handle 82 at the outer end so that the latch 79 may be rotated. Carriage guide 76 has a hole 83 at its outer end and another hole 84 at its inner end. When latch handle 82 is turned so that latch 79 fits into either of the two holes 83 or 84, the carriage 71 is locked in outer or inner position.

The carriage guide 76 is adjustable in position to accommodate die blocks of different depth. Thus the guide carries sleeves 86 at each of its four corners which receive vertical posts 48 projecting upwardly from base 88. Sleeves 86 are provided with spaced holes 89 in which fit pins 91 which hold the carriage guide in proper location.

In operation, the chuck 23 is caused to rotate with the tool A in upper position, as shown in Fig. 1, wherein the tool points 39 are in contact with the tool guide 51 which prevents them from spreading outwardly beyond the limits of the diameter of the bore 53 of the tool guide 51. The carriage 71 is retracted to the position shown in Fig. 1, whereupon the operator installs a blank C on the work-mounting plate 41, the corner-locating pieces 64 assisting in positioning the blank properly over the die block 57. The operator then turns the latch handle 82 and pushes the carriage 71 inwardly until it reaches the position shown in Fig. 2, whereupon the handle 82 is turned, causing latch 79 to engage the inner hole 84 locking the carriage in position. Thereupon the spindle 21 is slowly lowered while the tools 37 revolve. The tool points 39 move down the sloping sides of bore 53 until they contact the blank C and stretch the same, forcing it downwardly into contact with the internal bore 58 of die block 57. When the tool points 39 reach the bottom of the bore 58, the spindle 21 is raised to the position shown in Fig. 1 and the carriage 71 retracted, permitting removal of the completed workpiece and replacement with a new blank. It is well understood in the drill press art that the stem 21 may be raised and lowered automatically within the limits of movement shown in Figs. 1 and 3. The fact that the tool A revolves continuously enables the operator to remove a completed workpiece and install a new blank without stopping the machine.

In the modification shown in Fig. 5, the tool 92 is rotatable with respect to the tool holder 93. For such purpose, the upper end of the tool 92 is formed with a spindle 94 which is rotatively received by ball bearings 96 which are received in the bore 97 of holder 93. The upper bearing 96 is preferably of the thrust type.

Referring now to the modification shown in Fig. 6, the die block 57 is caused to reciprocate vertically in order to enable the new blank C to be installed and the completed workpiece to be removed. Accordingly the upper plate 41 is supported by legs 101 and the die mounting plate 102 to which block 57 is fixed is provided at its corners with rollers 103 which bear against the edges of legs 101 so as to confine the die block 57 for vertical movement. The die mounting plate 102 is attached to the upper end of piston rod 104 which extends upwardly from cylinder 106 mounted on the base 107 of the machine. Piston 108 is caused to rise by means of hydraulic pressure applied through hydraulic jack mechanism 109 of conventional construction. As illustrated in Fig. 6, a manually or pedally actuated handle 110 is provided to pump the jack 109, although mechanical means may be employed for this purpose.

In operation of the modification shown in Fig. 6, the pressure tending to raise piston 108 is released, permitting the die block 57 to lower and thereby exposing the work mounting plate 61 so that the operator can install a blank C in proper position over the die block 57. Thereupon hydraulic pressure is applied to piston 108 raising die block 57 to the position shown in Fig. 6, with the blanks C held between the work mounting plate 61 and top plate 41. The tool portion A has heretofore been in elevated position similar to the position of the tool shown in Fig. 1. After the blank is in position, the tool portion A is lowered until the blank is stretched into the shape shown in Fig. 6, whereupon the cycle of operation is complete.

The completed workpiece formed from the blank C comprises a marginal flat portion 111 and a cylindrical projection 112, the projection 112 conforming in shape to the internal bore 58 in die block 57. It will be noted that the axes of the projection 112 and the plane of marginal portion 111 are at an oblique angle which can be varied within practical limits by variation in the slope of the surfaces 56 and 59. Alternatively, the axis of projection 112 may be made normal to marginal portion 111. The angular relationship between the projection and the marginal flat portion enables the workpiece to be used as a flashing with margin 111 attached to a sloping roof and projection 112 extending vertically to receive a riser pipe, or the like.

Although the foregoing invention has been described in some detail by way of illustration and example for purposes of clarity of understanding, it is understood that certain changes and modifications may be practiced within the spirit of the invention and scope of the appended claims.

What is claimed is:

1. In a metal forming machine, a stem, means for rotat-

ing said stem, a tool attached to said stem for rotation therewith, means for moving said stem along its axis of rotation, a die having at least one position substantially in alignment with the axis of rotation of said stem, said tool being radially offset from the die surface, means biasing said tool radially outwardly from the axis of rotation of said stem toward said die, work-locating means for locating a metal blank above said die, a tool guide limiting outward biasing of said tool and guiding said tool while said tool is rotating into engagement with said blank, means stationarily mounting said tool guide adjacent said die when said die is in said first mentioned position, said die and tool guide shaped to receive a metal blank between their opposed faces to hold the blank on the die, said tool guide merging with and forming a continuation of said die when said die is in said first-mentioned position and means for moving said work locating means and die relative to said tool guide from a retracted position for loading and unloading said work locating means to a working position wherein said work locating means and die are aligned with said axis of rotation of said stem.

2. A machine according to claim 1 in which said means for moving said work-locating means and die comprises a carriage on which said die and work locating means are mounted and a carriage guide for moving said carriage substantially transverse to the axis of rotation of said stem.

3. A machine according to claim 1 in which said means for moving said die and work locating means moves substantially parallel to the axis of rotation of said stem.

4. A machine according to claim 1 in which said means for moving said die and work locating means moves substantially parallel to the axis of rotation of said stem, said means including fluid pressure means and means for controlling said fluid pressure means.

5. In a metal forming machine, a hollow die, means mounting said die, a tool guide, said tool guide and die being shaped to receive a metal blank between their adjacent faces to hold the blank on the die, said tool guide being formed with a bore of substantially the same diameter as the diameter of that portion of the hollow of said die adjacent said tool guide, said tool guide and the hollow of said die having a substantially common axis, means for moving said tool guide and die toward and away from each other to permit loading of a metal blank therebetween, a stem, means for rotating said stem about an axis in alignment with the axis of said die and guide, at least one tool carried by said stem for rotation therewith, means for moving said tool along said axis, and means biasing said tool outwardly to engage the sides of the bore of said tool guide whereby said tool is guided into said die as it moves along the axis of said stem.

6. A machine according to claim 5 in which said means for moving said tool has a limit of movement away from said die whereby said tool is confined within the bore of said tool guide.

7. In a metal forming machine, a hollow die, means mounting said die, a tool guide, said tool guide and die being shaped to receive a metal blank between their adjacent faces to hold the blank on the die, said tool guide being formed with a bore of substantially the same diameter as the diameter of that portion of the hollow of said die adjacent said tool guide, said tool guide and the hollow of said die having a substantially common axis, means for moving said tool guide and die toward and away from each other to permit loading of a metal blank therebetween, the adjacent faces of said tool guide and die being substantially parallel and oblique with reference to said common axis, a steam, means for rotating said stem about an axis in alignment with the axis of said die and guide, at least one tool carried by said stem for rotation therewith, means for moving said tool along said axis, and means biasing said tool outwardly toward the sides of the bore of said tool guide and of said die.

8. In a metal forming machine, a hollow die, means mounting said die, a tool guide, said tool guide and die being shaped to receive a metal blank between their adjacent faces to hold the blank on the die, said tool guide being formed with a bore of substantially the same diameter as the diameter of that portion of the hollow of said die adjacent said tool guide to guide said tool into said hollow, said tool guide and the hollow of said die having a substantially common axis, means for moving said tool guide and die toward and away from each other to permit loading of a metal blank therebetween, a stem, means for rotating said stem about an axis in alignment with the axis of said die and guide, at least one leaf spring on said stem and rotatable therewith, a tool carried by said leaf spring, said spring biasing said tool outwardly, and means for moving said tool along said axis.

9. A machine according to claim 8 which further comprises means permitting radial movement of said tool outward relative to said stem but preventing said tool from being twisted out of radial alignment relative thereto.

10. A machine according to claim 8 which further comprises a tool holder fixed to said leaf spring and holding said tool, and bearing means in said tool holder for rotative mounting of said tool relative to said leaf spring.

11. In a metal forming machine, a hollow die, means mounting said die, a tool guide, said tool guide and die being shaped to receive a metal blank between their adjacent faces to hold the blank on the die, said tool guide being formed with a bore of substantially the same diameter as the diameter of that portion of the hollow of said die adjacent said tool guide, said tool guide and the hollow of said die having a substantially common axis, means for moving said tool guide and die toward and away from each other to permit loading of a metal blank therebetween, a work holder on said die arranged to hold and locate a metal blank over said die, and tool means mounted to rotate about said axis and movable along said axis, and means biasing said tool means outwardly to engage the walls of the bore of said toolguide whereby said tool means is guided into said die as it moves along said axis.

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