June 19, 1951 L. B. GREEN 2,557,346

MULTIPLE-BEND METAL BENDING MACHINE

Filed June 12, 1948 7 Sheets-Sheet 1

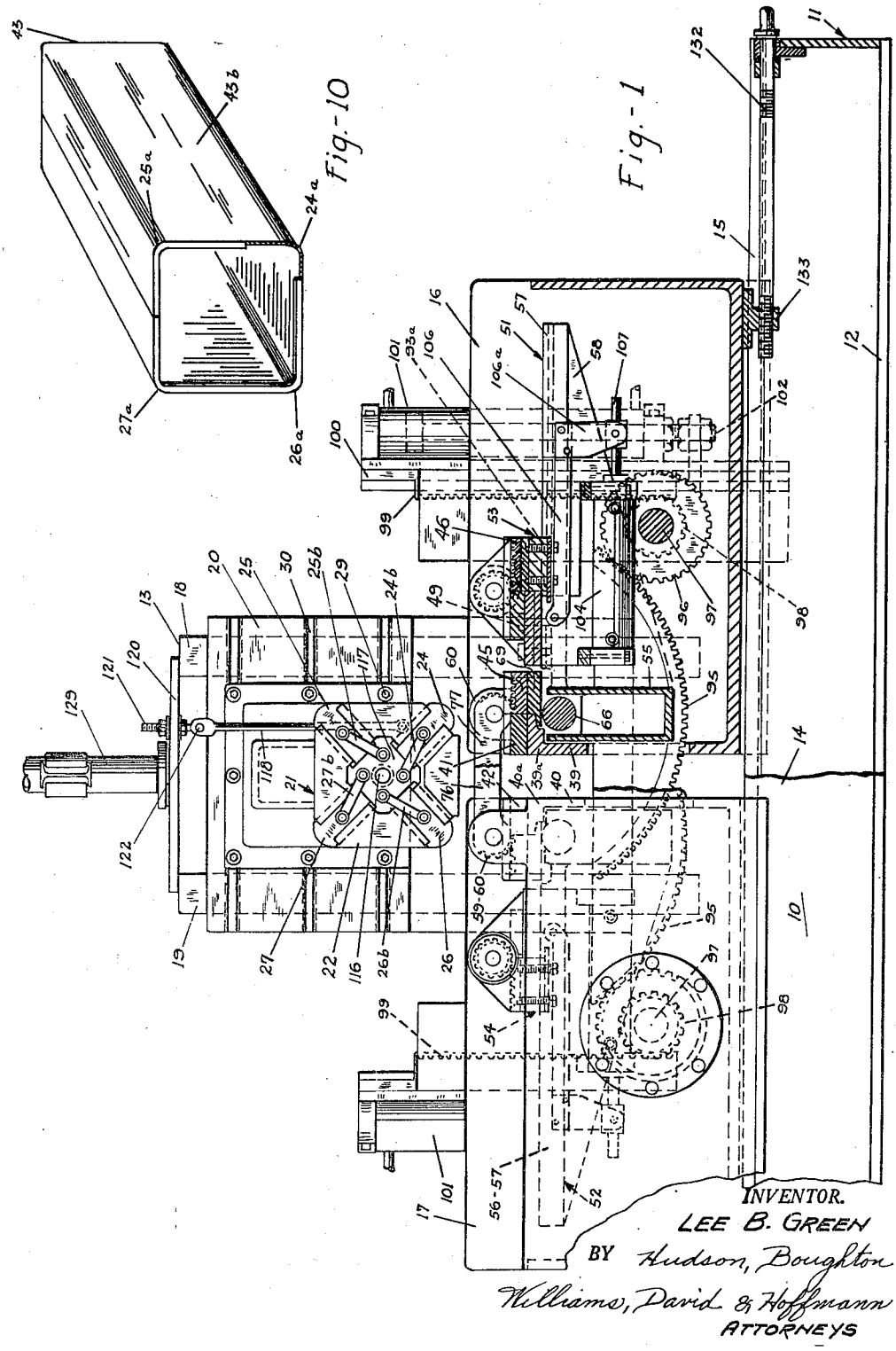


Fig. 10

Fig. 1

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MULTIPLE-BEND METAL BENDING MACHINE

Filed June 12, 1948 7 Sheets-Sheet 2

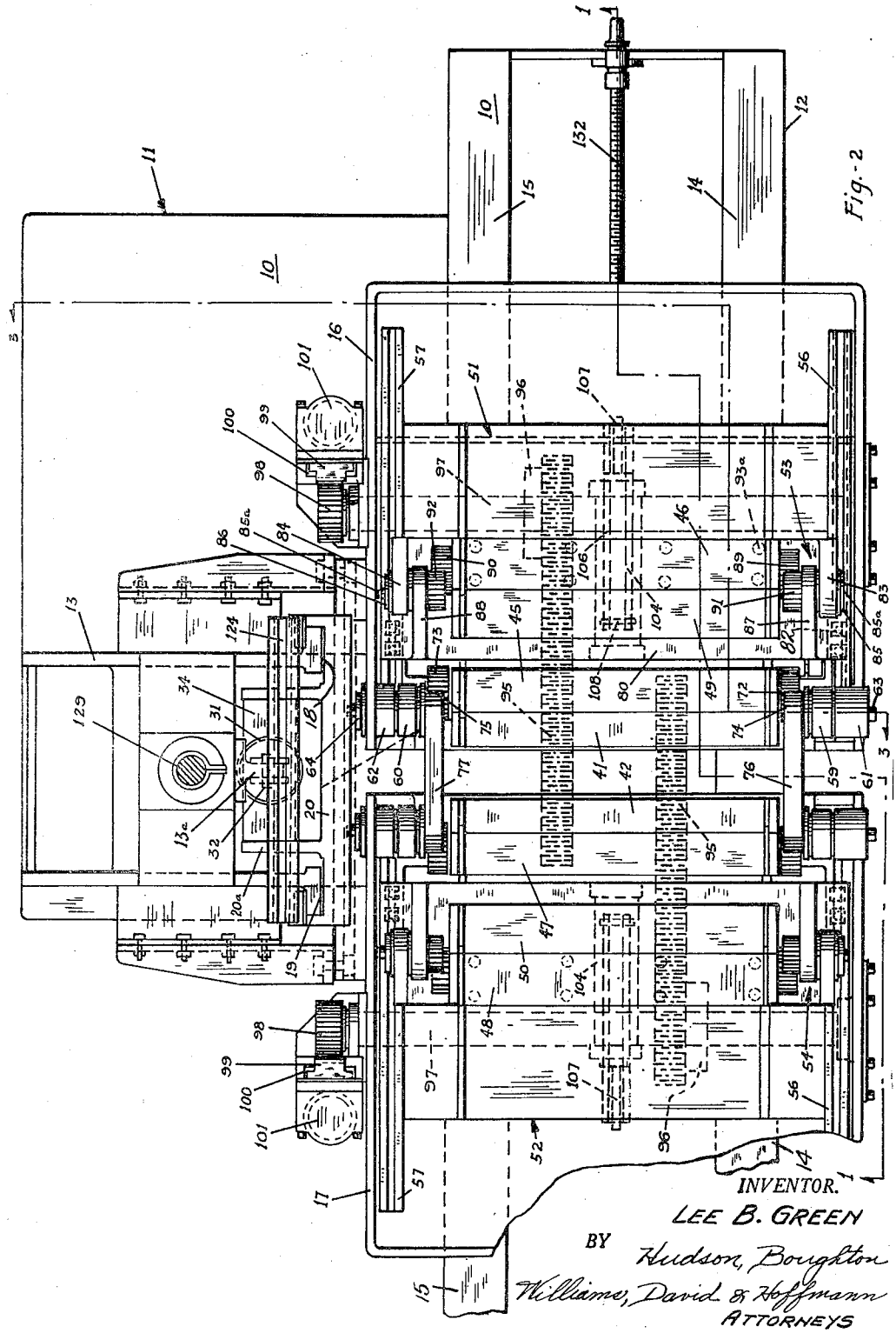


Fig. 2

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MULTIPLE-BEND METAL BENDING MACHINE

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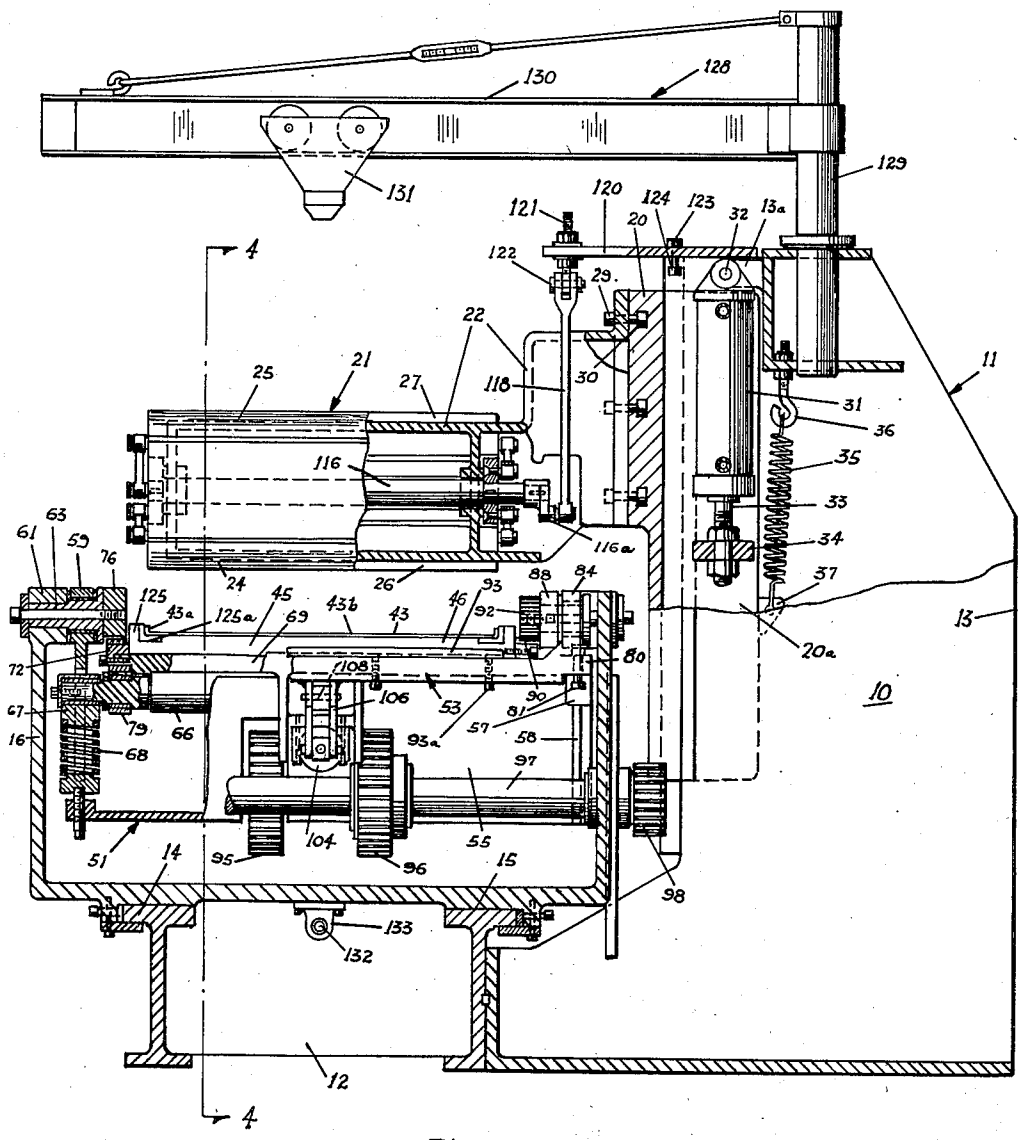


Fig. - 3

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MULTIPLE-BEND METAL BENDING MACHINE

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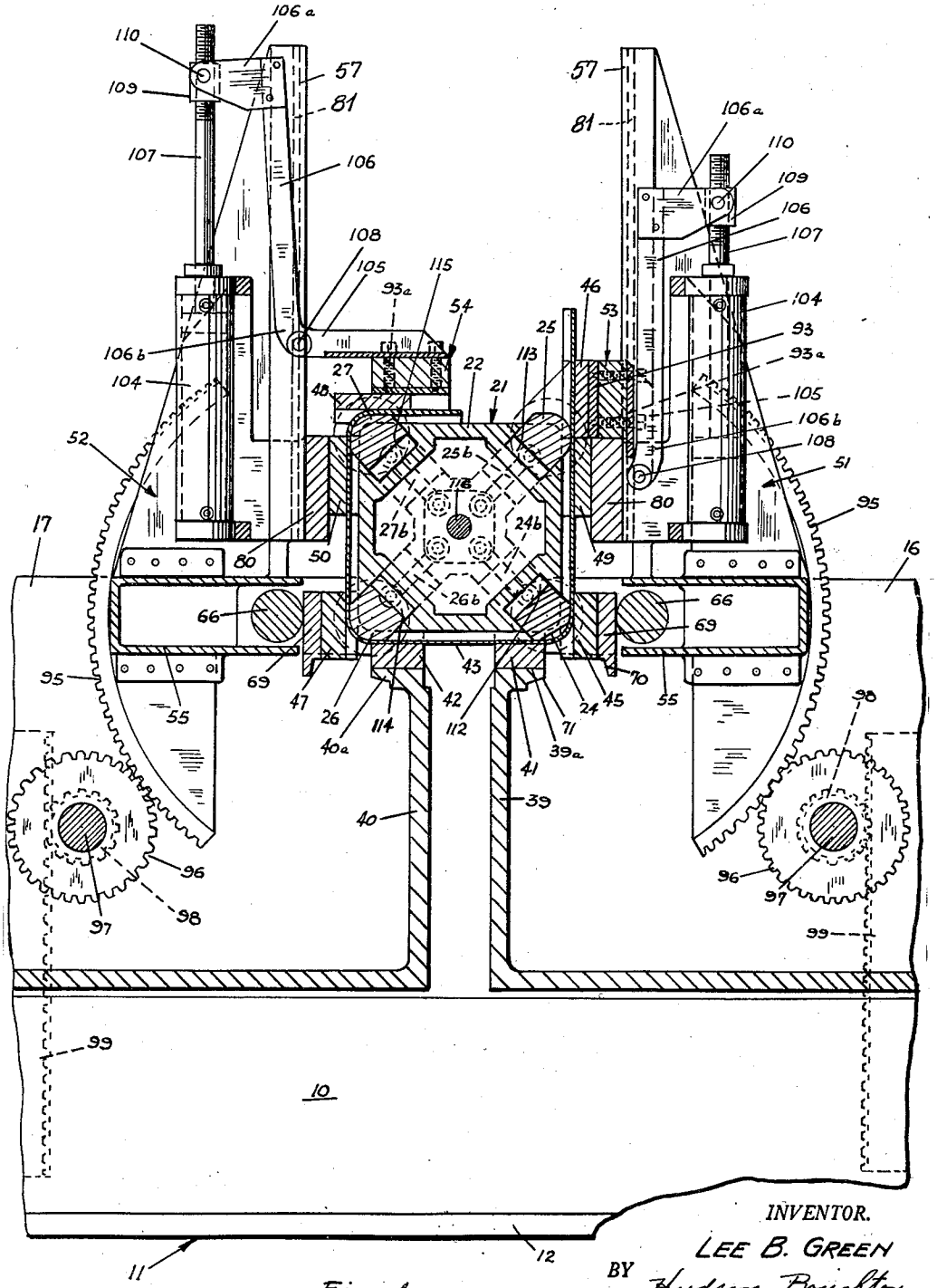


Fig. - 4

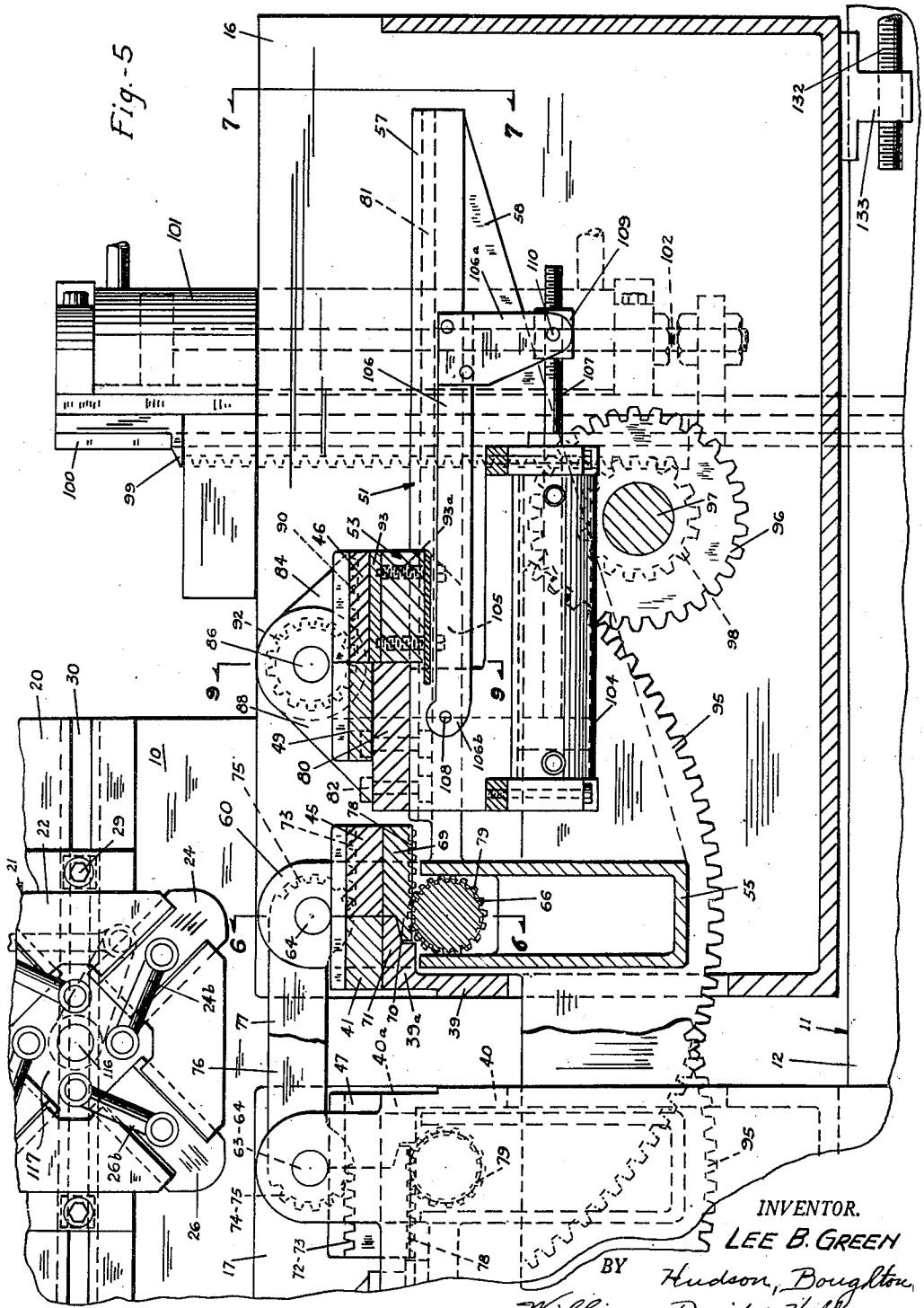
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Fig. 5



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MULTIPLE-BEND METAL BENDING MACHINE

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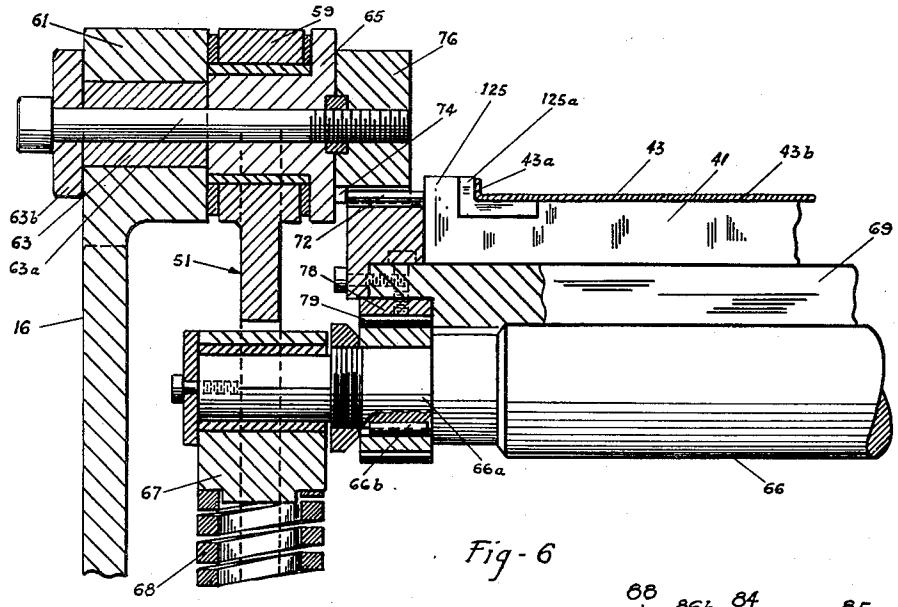


Fig - 6

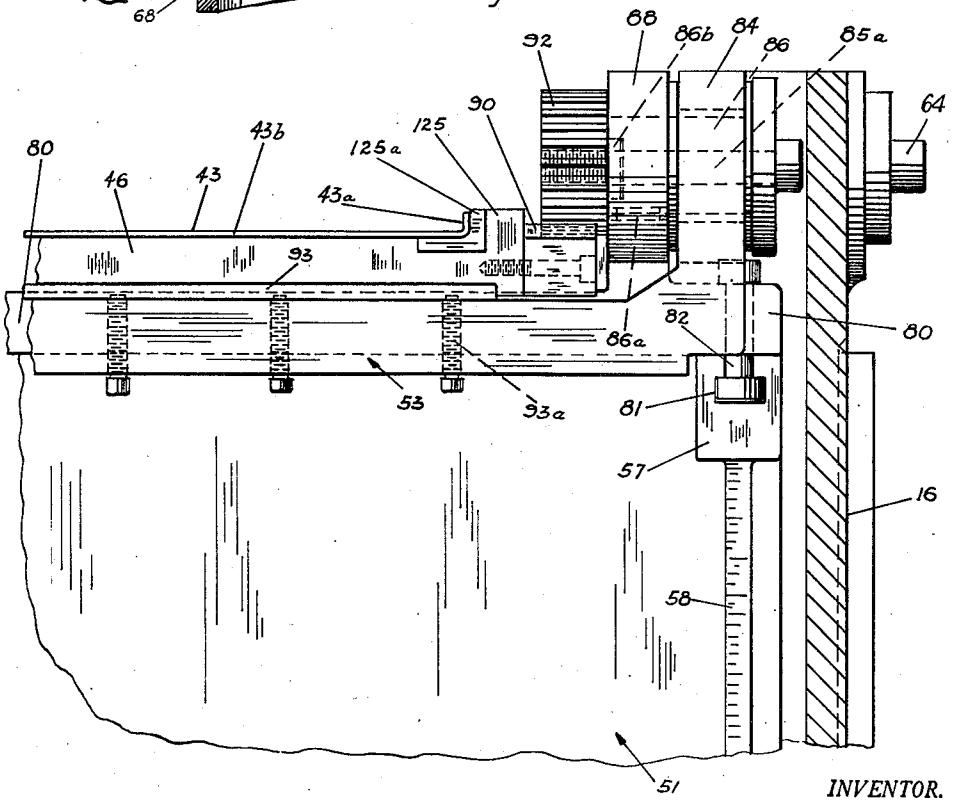


Fig. - 7

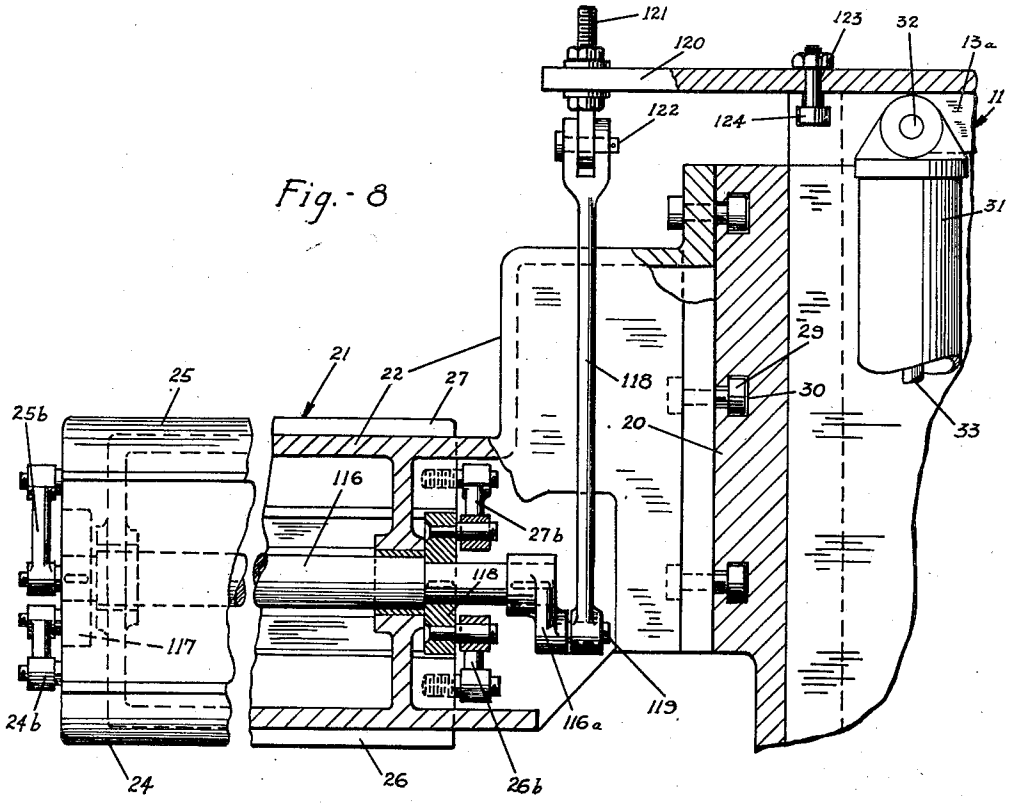
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MULTIPLE-BEND METAL BENDING MACHINE

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Fig. - 8



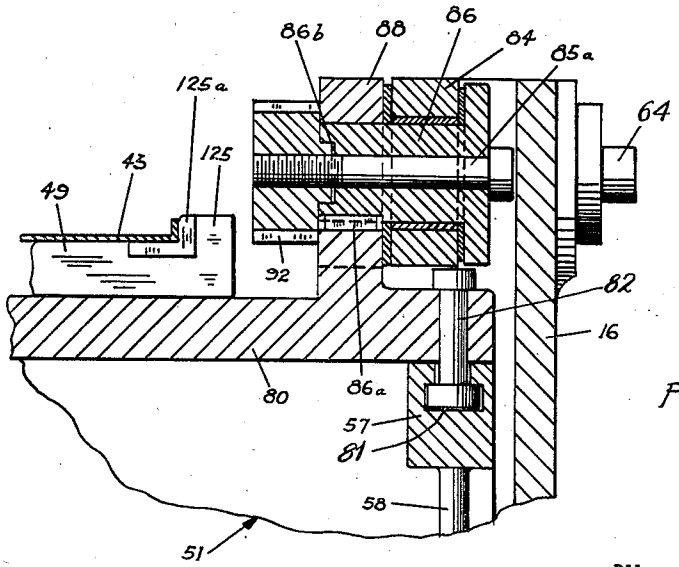


Fig. - 9

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Patented June 19, 1951

2,557,346

UNITED STATES PATENT OFFICE

2,557,346

MULTIPLE-BEND METAL-BENDING MACHINE

Lee B. Green, Lakewood, Ohio

Application June 12, 1948, Serial No. 32,657

20 Claims. (Cl. 153—39)

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This invention relates to bending machines of the kind used to form metal workpieces to desired shapes by performing bending operations thereon and, more particularly, this invention relates to an improved construction for a bending machine of this type.

The bending machines of this kind which have been proposed heretofore have, so far as I am aware, been adapted for forming in any one bending operation only a single bend in a workpiece or, at most, a pair of bends as in my earlier Patent No. 2,287,933, granted June 30, 1942. To bend an elongated workpiece to polygonal form with any of the machines heretofore available has required separate bending operations to be performed in succession on the workpiece with a shifting of the workpiece from one position to another and a reclamping of the workpiece, between the successive bending operations. Because of the limitations of these prior bending machines it has not been possible, heretofore, to bend elongated workpieces to polygonal form with satisfactory accuracy nor in a rapid and economical manner.

For use in certain manufactured metal products, it is desirable to form an elongated metal workpiece having one or more longitudinal flanges to a polygonal shape to constitute a housing, container body or other member in which the flange or flanges of the workpiece provide an in-turned flange at one or both ends of such member. To accomplish this the workpiece must be bent at spaced points therealong by bending the web portion out of its own plane and simultaneously bending the flange portions within their own planes. So far as I am aware, no metal bending machine has been designed heretofore which is capable of carrying out such bending of a flanged workpiece to polygonal shape in one bending operation. Moreover, I am not aware of any prior bending machine in which two bends can be formed in a given portion of a flanged workpiece as successive steps of a single bending operation and in which the bending of the flange portions in their own planes is accomplished without wrinkling or buckling of the metal.

As one of its objects, this invention provides an improved bending machine by which the bending of a metal workpiece, or a longitudinally flanged metal workpiece, to a desired shape can be carried out accurately and in a rapid and economical manner.

Another object of the invention is to provide an improved bending machine in which the

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forming of a metal workpiece to a polygonal shape can be carried out as a single bending operation so that it will only be necessary to place the workpiece in the machine and subsequently remove the polygonally shaped article and no intermediate handling or reclamping of the workpiece between successive bending steps will be necessary.

A further object is to provide an improved machine of this character having a die unit embodying multiple anvil die members and in which multiple bends, for example quadruple bends, are formed in the workpiece by bending the same around such die unit as a single bending operation.

Still another object is to provide an improved bending machine of the character mentioned having a swinging wing which carries a plurality of bending dies adapted to form a plurality of bends in a metal workpiece, or in a longitudinally flanged metal workpiece, as successive steps of a single bending operation.

Yet another object is to provide an improved bending machine of this character having a die unit embodying multiple anvil die members and also having a pair of wings each carrying a plurality of bending dies, and in which the wings are adapted to swing toward the die unit and cause the bending dies to form a plurality of bends in a metal workpiece, or in a longitudinally flanged metal workpiece, as successive steps of a single bending operation.

As another of its important objects, this invention provides an improved bending machine of the type embodying an anvil die means and a bending die means rockable around said anvil die means for bending a metal workpiece, or a longitudinally flanged metal workpiece, thereabout and in which one portion of the bending die means is carried by a swinging main wing and another portion of the bending die means is carried by an auxiliary wing which is movable relative to the main wing.

Still another object is to provide an improved bending machine of the character mentioned in which the auxiliary wing is pivotally mounted on the main wing and forms an extension thereof and is actuated by a power device also carried by the main wing.

As a further object this invention provides an improved bending machine having an anvil die and a bending die rockable around the anvil die by the action of a swinging wing for bending a metal workpiece around the anvil die, and in which the bending die is mounted on the wing so

as to have substantially parallel movement, preferably sliding movement, relative thereto.

Yet another object is to provide an improved bending machine having an anvil die unit embodying anvil die members disposed in a polygonal arrangement and also having bending die means rockable around the anvil die unit so as to bend a metal workpiece, or a longitudinally flanged metal workpiece, therearound to a polygonal shape by forming a plurality of bends in the workpiece as successive steps of a single bending operation.

A further object is to provide such an improved bending machine in which the anvil die unit is contractable to facilitate the removal of the polygonally shaped workpiece therefrom.

Still another object is to provide an improved bending machine in which an anvil die unit embodying a plurality of anvil die members disposed in a polygonal arrangement is adapted for clamping engagement with a workpiece and in which bending die means rockable around the anvil die unit for bending the workpiece to polygonal shape therearound is actuated, in part, by swinging main wings and, in part, by swinging auxiliary wings carried by the respective main wings.

The invention can be further briefly summarized as consisting in certain novel combinations and arrangement of parts hereinafter described and particularly set out in the claims hereof.

In the accompanying sheets of drawings,

Fig. 1 is a front view partly in section of a bending machine embodying the present invention, the view being taken substantially as indicated by section line 1—1 of Fig. 2;

Fig. 2 is a plan view of the machine but with the anvil die unit omitted;

Fig. 3 is a transverse vertical section taken substantially on the irregular section line 3—3 of Fig. 2;

Fig. 4 is a partial longitudinal vertical section taken on line 4—4 of Fig. 3 and showing the bending of the workpiece to polygonal shape nearly completed;

Fig. 5 is a partial longitudinal vertical section corresponding with a portion of Fig. 1, but showing the same on a larger scale;

Fig. 6 is a partial transverse vertical section taken through the machine adjacent the front thereof at approximately the longitudinal location indicated by section line 6—6 of Fig. 5;

Fig. 7 is a partial vertical section taken through the machine adjacent the rear thereof at approximately the longitudinal location indicated by the section line 7—7 of Fig. 5;

Fig. 8 is a transverse vertical section corresponding with the portion of Fig. 3 which shows the anvil die unit, but illustrating such unit on a larger scale;

Fig. 9 is a partial transverse vertical section taken through one of the pivots of an auxiliary wing as indicated by section line 9—9 of Fig. 5; and

Fig. 10 is a perspective view, with portions broken away, showing a workpiece which has been bent to polygonal shape by the improved machine.

As shown in the drawings, the improved bending machine 10 is provided with a frame 11 having a longitudinally extending bed portion 12 and also having an upright portion 13 located at one side of the bed portion 12 at an intermediate point thereof. The bed portion 12 embodies a pair of laterally spaced longitudinally extending front and rear ways 14 and 15 on which a pair of longitudinally spaced frame sections 16 and 17 are mounted and are longitudinally adjustable. The upright frame portion 13 has a pair of spaced vertical ways 18 and 19 thereon on which is mounted a vertically movable die-carrying slide 20.

The die slide 20 provides a movable mount for an anvil die unit 21 which will be described in greater detail hereinafter and which comprises, in general, a die carrier 22 in the form of an elongated bracket extending transversely of the machine above the adjacent ends of the frame sections 16 and 17 and a group of correspondingly elongated anvil die members 24, 25, 26 and 27 which have curved working faces and are disposed in a polygonal arrangement and movably mounted in such die carrier. The die carrier 22 is attached to the die slide 20 as by means of the bolts 29 which engage in the T-slots 30 of the slide.

The die slide 20 is adapted to be moved downwardly on the upright ways 18 and 19 by a suitable power device such as the cylinder 31 (see Figs. 2 and 3) mounted on the upright frame portion 13 by having its upper end connected with a lug 13a of such frame portion by means of the pivot pin 32. The cylinder 31 is a double-acting cylinder adapted to be supplied with liquid under pressure, or other suitable motive fluid, and has a piston rod 33 projecting from the lower end thereof and connected to a transverse bar portion 34 of the die slide 20. The bar portion 34 extends between, and has its ends connected to, the rearwardly projecting vertical flanges 20a of the die slide. Suitable counterbalancing means may be provided for the slide 20, such as the tension spring 35, having its upper end anchored on the frame 11 as by means of the eye-bolt 36 and its lower end attached to the projecting lug 37 of the slide.

The frame sections 16 and 17 are box-like structures provided at their adjacent ends with upright walls 39 and 40 which carry table portions 39a and 40a (see Figs. 1 and 5) extending transversely of the machine beneath the anvil die unit 21. Work clamping dies 41 and 42 of a generally flat shape are mounted in fixed relation on the table portions 39a and 40a and are adapted to be clampingly engaged by portions of the anvil die members 24 and 26 when the die unit 21 is moved downwardly by the power cylinder 31. Fig. 4 of the drawings shows an elongated workpiece 43 in the machine and having an intermediate portion thereof clamped at spaced points by the action of the anvil die members 24 and 26 in cooperation with the clamping die members 41 and 42.

As will be explained in greater detail hereinafter, the portions of the workpiece 43 which extend in opposite directions from the intermediate portion which is clamped between the anvil die members 24, 26 and the clamping die members 41, 42 are bent upwardly and around the die unit 21 to form the workpiece into the polygonal part or article illustrated in Fig. 10. In carrying out this operation longitudinally spaced portions of the workpiece 43 are bent around the anvil die members 24 and 25 to form the bends 24a and 25a and other longitudinally spaced portions of the workpiece are bent around the anvil die members 26 and 27 to form the bends 26a and 27a. The bending of the longitudinally spaced portions of the workpiece around the anvil die members 24 and 25 is accomplished by a pair of generally flat

main and auxiliary bending dies 45 and 46 and the bending of the other longitudinally spaced portions of the workpiece around the anvil die members 26 and 27 is accomplished by another pair of generally flat main and auxiliary bending dies 47 and 48. During the bending of portions of the workpiece 43 around the anvil die members 25 and 27, the immediately adjacent portions of the workpiece are held in clamped relation against portions of these same anvil die members by generally flat auxiliary clamping dies 49 and 50.

The bending dies 45 and 46 together with the clamping die 49 constitute one group of die members which is carried by a main wing 51, and the bending dies 47 and 48 together with the clamping die 50 constitute another group of die members which is carried by a similar main wing 52. The auxiliary bending dies 46 and 48 are carried respectively by auxiliary wings 53 and 54 which, as explained in greater detail hereinafter, are mounted on the main wings 51 and 52 for swinging movement relative thereto. The main wings 51 and 52 are located, respectively, in the frame sections 16 and 17 and are pivotally mounted thereon for swinging movement upwardly and toward the anvil die unit 21 from opposite sides thereof, as shown in Fig. 4. The auxiliary wings 53 and 54 constitute extensions of the main wings and are adapted to swing inwardly and downwardly toward the anvil die unit 21, as is also shown in Fig. 4.

The main wings 51 and 52 are substantially identical in construction and are actuated in the same manner, and hence, only one of these main wings and its actuating mechanism need be described in detail herein. This is also the case for the auxiliary wings 53 and 54. The mechanisms of the main and auxiliary wings which are associated with the pairs of bending dies 45, 46 and 47, 48 are the same for both pairs of dies and need be described in detail for only one of the main wings, such as the wing 51, and for only one of the auxiliary wings, such as the auxiliary wing 53. Since, as explained above, the constructions are the same for the main wings 51 and 52 and the mechanisms associated therewith, and are the same for the auxiliary wings 53 and 54 and the mechanisms associated therewith, the same reference characters have been applied to corresponding parts.

The main wing 51 comprises a substantially rigid bracket-like structure having a hollow body portion 55 extending transversely of the machine and a pair of laterally spaced front and rear arm portions 56 and 57 extending longitudinally of the machine. The arms 56 and 57 are integrally connected with or welded to the transverse hollow body portion 55 and are also connected with the latter by means of the angular bracing webs 58. The wing 51 is also provided with a pair of spaced front and rear arms 59 and 60 by which it is pivotally mounted on the frame section 16. As shown in Figs. 2 and 6, the wing 51 can be pivotally connected with the frame section 16 by providing the latter with a pair of front and rear bosses 61 and 62 carrying front and rear pivot members 63 and 64 having shouldered portions 65 on which the arms 59 and 60 of the wing are pivotally mounted. The pivot members 63 and 64 are retained in the bosses 61 and 62 as by means of the clamping bolt 63^a and washer 63^b (see Fig. 6).

The main wing 51 is also provided with a pressure roller 66 located in the hollow body portion 55 adjacent the top thereof and having its ends journaled in bearing members 67 which are slidably mounted in the wing so as to adapt the roller for movement toward and away from the axis of the pivot members 63 and 64. Compression springs 68 mounted in the wing act on the bearing members 67 and normally urge the roller 66 toward the pivot axis of the wing.

The main bending die 45 is located between the arms 59 and 60 of the main wing 51 and is mounted on a carrier in the form of a die plate 69 which extends transversely of the machine and has a beveled edge portion 70 shaped for cooperating engagement with the beveled portion 71 of the adjacent edge of the table 39^a when the bending die is in its initial or work-receiving position. The die plate 69 is provided with front and rear rack elements 72 and 73 on the upper side thereof which mesh with front and rear arcuate gear elements or sectors 74 and 75. The gear sectors 74 and 75 are provided in fixed relation on the frame 11 and, in this instance, are carried by front and rear links 76 and 77 by which the adjacent ends of the frame sections 16 and 17 are connected together. The die plate 69, with the main bending die 45 thereon, is supported by the roller 66 and the racks 72 and 73 of the die plate 69 are held in mesh with the gear sectors 74 and 75 by the action of the springs 68 which press the roller 66 against the under side of the die plate. The die plate 69 is also provided on the under side thereof with front and rear racks 78 and the roller 66 is provided adjacent its ends with gears 79 which mesh with these racks (see Fig. 6). The gears 79 are mounted on reduced end portions 66^a of the rollers 66 and are connected for rotation therewith by means of the keys 66^b. The action of the springs 68 also holds the gear 79 of the roller 66 in mesh with the racks 78 of the die plate. The main bending die 47 is supported by another such die plate 69.

The auxiliary clamping die 49 is mounted on a die carrier 80 which is supported by the arms 56 and 57 of the main wing 51. The die carrier 80 is a plate-like member which is adjustable on the main wing 51 in a direction longitudinally of the machine and relative to the table 39^a so that the point of the workpiece at which the bend 25^a is to be formed can be varied with respect to the location at which the bend 24^a is formed. To permit this adjustment the arms 56 and 57 of the main wing 51 are constructed so as to constitute ways on which the die carrier 80 is movable and have longitudinal T-slots 81 therein with which the bolts 82 cooperate for locking the die carrier in fixed relation on the main wing at the desired position of adjustment. The auxiliary clamping die 50 is supported by another such die carrier 80.

The auxiliary bending die 46 is mounted on the auixiliary wing 53 by which it is carried during the bending operation, and similarly, the auxiliary bending die 48 is mounted on the auxiliary wing 54. The auxiliary wing 53 is a plate-like structure having a pair of spaced front and rear arms 83 and 84 on the upper side thereof by which it is pivotally mounted on a pair of front and rear pivot members 85 and 86. The generally flat plate-like portion of the wing 53 can also be conveniently referred to as a platen portion since it carries the bending die 46 and applies pressure to the workpiece through this die during the bending operation. These pivot members 85 and 86 are carried, respectively, by a pair of front and rear arms 87 and 88 which are formed integral on the upper side of the die car-

rier 80. The auxiliary wing 53 is provided with a pair of front and rear rack elements 89 and 90 on the upper side thereof which mesh with front and rear pinions or gear sectors 91 and 92 carried by the pivot members 85 and 86, respectively. The pivot members 85 and 86 are retained in the arms 87 and 88 by means of bolts 85a (see Figs. 2 and 9) and are held against rotation by the keys 86a. The gear sectors 91 and 92 are connected with the pivot members 85 and 86 by means of the bolts 85a and are held from rotating relative to the pivot members by the key elements 86b.

The bending die 46 is not mounted in fixed relation on the auxiliary wing 53 but is capable of substantially parallel sliding movement relative thereto. For this purpose, the auxiliary wing 53 is provided with a bearing plate 93 on which the auxiliary bending die 46 is slidable during swinging of the auxiliary wing. The position of the auxiliary bending die 46 relative to the auxiliary wing 53 can be adjusted by means of suitable pressure screws 93a mounted in the auxiliary wing and which apply pressure to the under side of the bearing plate. The action of the screws 93a also holds the racks 89 and 90 in proper mesh with the gears 91 and 92.

The above-mentioned swinging movement is imparted to the main wing 51 by means of a gear sector 95 which is rigidly attached to the wing and a driving gear 96 meshing with such sector and driven by a shaft 97. The shaft 97 extends transversely of the machine and is suitably journaled in the upright walls of the frame section 16. One end of the shaft 97 extends beyond the upright rear wall of the frame section 16 and carries a pinion 98 which is engaged by a vertically disposed power rack 99. The rack 99 is movable in a guideway 100 and is adapted to be actuated by a double-acting power cylinder 101 to which liquid or other suitable motive fluid under pressure is adapted to be supplied. The rack 99 is attached to a piston rod 102 projecting from the lower end of the cylinder 101 so that a power stroke of the cylinder in one direction will swing the main wing 51 upwardly on the pivot members 63 and 64 to cause bending of the workpiece 43 around the die unit 21 and a power stroke of the cylinder 101 in the opposite direction will return the main wing to its initial position, as shown in Figs. 2 and 5. The cylinder 101 can be suitably mounted on the frame section 16 in the substantially upright relation shown in the drawings. The main wing 52 is actuated in a similar manner by another such power cylinder 101 mounted in upright relation on the frame section 17.

The auxiliary wing 53 is adapted to be swung on the pivot members 85, 86 and relative to the main wing 51 by a suitable power device carried by the main wing. In this instance the power device for actuating the auxiliary wing 53 is a double-acting cylinder 104 to which liquid or other suitable motive fluid under pressure is adapted to be supplied. The auxiliary wing 53 has an actuating arm 105 rigidly connected therewith and to which actuating movement is supplied by the power cylinder 104. For this purpose, a bellcrank lever 106 is employed to transmit such motion to the auxiliary wing and has an arm portion 106a pivotally connected with a piston rod 107 projecting from the power cylinder 104 and an arm portion 106b pivotally connected with the actuating arm 105 of the auxiliary wing by the pivot pin 108. The connection of the bellcrank lever 106 with the piston rod 107 can be made as an adjustable connection by providing a nut 109 on a threaded portion of the piston rod and to which nut the arm portion 106a is pivotally connected by the pivot pin means 110.

Reverting now to the anvil die unit 21, it should be explained that the die carrier 22 is of a substantially polygonal cross-sectional shape, in this instance quadrangular, and has longitudinal slots 112, 113, 114 and 115 formed therein in which the anvil die members 24, 25, 26 and 27 are disposed, respectively. The slots 112, 113, 114 and 115 are located so as to extend along the corners of the die carrier 22 and form guideways in which the anvil die members 24, 25, 26, and 27 are movable in a substantially radial direction with respect to the longitudinal axis of this die carrier. This radial movement of the anvil die members in the carrier 22 renders the die unit expansible and contractable.

When the die unit 21 is in its initial position, that is to say in the inoperative position spaced above the clamping dies 41 and 42 as shown in Fig. 3, the anvil die members 24, 25, 26 and 27 are in their retracted position. When the die unit 21 is moved downwardly by the die slide 20 to cause the anvil die members 24 and 26 to cooperate with the clamping dies 41 and 42 to clamp the intermediate portion of the workpiece 43 therebetween, all of the anvil die members 24, 25, 26 and 27 are in their projected or extending position as shown in Fig. 4. When the die unit 21 is moved upwardly to its initial position after the bending of the workpiece 43 therearound, the anvil die members 24, 25, 26 and 27 are again retracted and the resulting contracted condition of the die unit permits the polygonally shaped workpiece to be more readily removed therefrom by endwise axial movement of the formed workpiece relative to the die carrier 22.

The anvil die members 24, 25, 26 and 27 of the die unit 21 are extended and retracted relative to the die carrier 22 by means of pairs of links 24b, 25b, 26b and 27b which transmit pushing and pulling forces to the anvil die members in response to rotation of an actuating shaft 116 relative to the die carrier 22 in which this shaft is rotatably journaled. The shaft 116 has front and rear drive plates 117 and 118 keyed thereto at longitudinally spaced points, as shown in Fig. 8, and with which the anvil die members 24, 25, 26 and 27 are connected by the pairs of front and rear links 24b, 25b, 26b and 27b. When the shaft 116 is rotated in a counterclockwise direction, as viewed in Fig. 1, the links 24b, 25b, 26b and 27b will impart outward or expanding movement to the anvil die members 24, 25, 26 and 27, thereby shifting these members to their extended position shown in Fig. 4 which corresponds with the expanded condition of the die unit. When the shaft 116 is rotated in the opposite direction, that is in a clockwise direction as viewed in Fig. 4, the links will be made to again assume their relative angular positions shown in Fig. 1, thereby moving the anvil die members inwardly to the position of Fig. 1 which corresponds with the contracted condition of the die unit 21.

The rotary movement for expanding and contracting the die unit 21 can be imparted to the shaft 116 by any suitable power means, but in this instance the actuating movement imparted to the die slide 20 by the power cylinder 30 is also used to cause such actuation of the shaft 116. For this purpose the shaft 116 is provided with an actuating lever 116a at its rear end and an actuating link 118 provides an operating connection between this lever and the frame 11. The

link 118 has one end thereof pivotally connected with the lever 116a by the pivot pin 119 and has its opposite end connected with the frame 11 by means of the bar 120 and an eye-bolt 121 carried by such bar. The link 118 has its upper end pivotally connected with the eye portion of the bolt 121 by means of the pivot pin 122. The bar 120 is connected with the frame 11 by means of one or more bolts 123 engaging in a T-slot 124 and providing for adjustment of the bar relative to the frame.

The workpiece 43 may be a strip-like sheet-metal member which is to be bent to a polygonal form, for example the quadrangular cross-sectional shape shown in Fig. 10. Usually the workpiece 43 will have a longitudinal edge flange 43a extending along one or both side edges thereof. During the bending operation which forms the bends 24a, 25a, 26a and 27a the web portion 43b of the workpiece is bent out of its own plane and the edge flanges 43a are bent within their own planes. To prevent wrinkling or buckling of the edge flanges 43a during such bending thereof the groups of clamping and bending dies 41, 45, 46, 49 and 42, 47, 48, 50 are provided with angular portions or flanges 125 which cooperate with the end faces of the anvil die members 24, 25, 26 and 27 in holding the edge flanges 43a of the workpiece against wrinkling or buckling during the bending of the workpiece around such anvil members. The angular portions 125 of the clamping and bending dies can be formed as integral portions of these dies and, if desired, may include hardened insert members 125a.

In the operation of the bending machine 10 above described, the elongated sheet metal workpiece 43 is placed in the machine so as to be supported on the main and auxiliary bending dies 45, 46, 47 and 48, which die members are then in their initial position in which they are in a substantially horizontally aligned relation longitudinally of the machine as shown in Figs. 1 and 2. The workpiece is at this time also supported, in part, by the main and auxiliary clamping dies 41, 49, 42, and 50 which are then in aligned relation with the main and auxiliary bending dies. The power cylinder 31 is then operated to move the anvil die unit 21 downwardly into clamping cooperation with the main clamping dies 41 and 42. This downward movement of the die unit 21 causes the anvil die members 24, 25, 26 and 27 thereof to be projected to their extended position, as explained above, and also causes portions of the anvil die members 24 and 26 to clamp corresponding portions of the workpiece 43 against the main clamping dies 41 and 42.

The main wings 51 and 52 are now swung upwardly by actuation of the power cylinders 101 which impart downward movement to the power racks 99. As explained above, the downward movement of the racks 99 causes rotation of the shafts 97 in a direction to cause such upward swinging of the main wings 51 and 52 by the action of the driving gears 96 on the gear sectors 95. The upward swinging of the main wings 51 and 52 causes the main bending dies 45 and 47 to rock tangentially around the anvil die members 24 and 26, respectively, and to thereby bend the workpiece 43 around these anvil die members, as shown in Fig. 4, for forming the bends 24a and 26a.

During the rocking of the main bending dies 45 and 47 around the anvil die members 24 and 26, these bending dies are pressed against the workpiece and the rack elements 72, 73 for these bending dies are maintained in mesh with the gear sectors 74, 75 by the pressure of the pressure rollers 66 acting on the under side of the die plates 69 on which the bending dies 45 and 47 are mounted. The engagement of the rack elements 72, 73 with the gear sectors 74, 75 also prevents skewing of the main bending dies or slipping of these dies relative to the work. During such rocking of the main bending dies 45 and 47 around the anvil die members 24 and 26, the main wings 51 and 52 also move relative to the bending dies so that the point of engagement of the pressure rollers 66 shifts on the die plates 69 from the location shown in Figs. 1 and 5 to the location shown in Fig. 4. The angular portions or flanges 125 of the main clamping and bending dies 41, 45 and 42, 47 cooperate with the end faces of the anvil die members 24 and 26 in holding the edge flanges 43a of the workpiece against buckling or wrinkling.

The upward swinging of the main wings 51 and 52 to cause bending of the portions of the workpiece 43 around the anvil die members 24 and 26, as just explained above, also causes the auxiliary clamping dies 49 and 50 to be moved into clamping cooperation with portions of the anvil die members 25 and 27, respectively, so as to clamp portions of the workpiece against the latter, as shown in Fig. 4. When the main wings 51 and 52 have been swung to their upward position, as shown in Fig. 4, they are maintained in this position and the auxiliary wings 53 and 54 are then swung toward each other and relative to the main wings to thereby actuate the auxiliary bending dies 46 and 48 and cause bending of the end portions of the workpiece 43 toward each other and around the anvil die members 25 and 27 to form the bends 25a and 27a. During this swinging of the auxiliary wings 53 and 54, the auxiliary bending dies 46 and 48 rock tangentially around the anvil die members 25 and 27, respectively, thereby causing the end portions of the workpiece 43 to be bent around these anvil die members. The above-described bends 24a and 25a constitute the pair of bends produced by operation of the main wing 51 and of these bends the bend 24a can be referred to as the first bend and the bend 25a as the second bend. Similarly the bends 26a and 27a constitute the pair of bends produced by the main wing 52 and of these bends the bend 26a can be designated the first bend and the bend 27a as the second bend.

The rack elements 89, 90 for the auxiliary bending dies 46 and 48 are in mesh with the gear sector 91, 92 and prevent skewing of the auxiliary bending dies or slipping of these dies relative to the workpiece. Since the auxiliary bending dies 46 and 48 are not rigidly connected to the auxiliary wings 53 and 54, but are slidable on the bearing plates 93 carried by the auxiliary wings, it will be seen that relative sliding movement will occur between the auxiliary bending dies and the auxiliary wings during this rocking of the auxiliary bending dies around the anvil die members 25 and 27. The extent of such relative sliding movement is illustrated in Fig. 4 for the auxiliary bending die 48.

During the bending of the workpiece accomplished by the auxiliary bending dies 46 and 48, that is to say during the forming of the bends 25a and 27a, the angular portions 125 of the auxiliary bending dies cooperate with the end faces of the anvil die members 25 and 27 for preventing wrinkling or buckling of the edge flanges 43a of the workpiece. The swinging of

the auxiliary wings 53 and 54 for actuating the auxiliary bending dies 46 and 48 during the bending operation and for returning these dies after the completion of the bending operation, is accomplished by the above-described power cylinders 104 which are carried by the main wings 51 and 52 and transmit such movement to the auxiliary wings through the bellcrank levers 106.

After the various portions of the workpiece have been bent around the anvil die members 24, 25, 26 and 27 to form the bends 24*a*, 25*a*, 26*a* and 27*a*, as explained above, the auxiliary wings 53 and 54 are returned to their initial position by the cylinders 104 and then the main wings 51 and 52 are returned to their initial position by actuation of the power cylinders 101. The workpiece 43 which has been bent to a polygonal cross-sectional shape, as shown in Fig. 9, remains on the anvil die unit 21 in surrounding relation to the carrier 22 and the anvil die members thereof. The power cylinder 31 is now actuated to impart upward movement to the die slide 20 and the anvil die unit 21 carried thereby. This upward movement of the die unit 21 causes retraction of the anvil die members in the manner explained above, which permits the polygonally formed workpiece to be withdrawn from the die unit 21 by endwise movement relative thereto.

In connection with the operation of the machine 10 it should be understood that the main wings 51 and 52 can be actuated simultaneously and likewise the auxiliary wings 53 and 54 can be actuated simultaneously. It is not necessary, however, that the main wings be actuated simultaneously nor that the auxiliary wings be actuated simultaneously and, if desired, the main wings can be actuated in succession and the auxiliary wings can likewise be actuated in succession. When the main and auxiliary wings are actuated simultaneously the bending operation can be performed in a shorter time interval but, on the other hand, when the main and auxiliary wings are actuated in succession a lighter load is imposed on the power mechanism of the machine.

As shown in the drawings the machine 10 may include an auxiliary crane 128 comprising an upright post or standard 129 pivoted on the frame 11 and a cantilever arm 130 having a trolley device or hoist 131 mounted for longitudinal traveling movement thereon. The crane 128 can be used for handling formed workpieces or for handling the die unit 21 when the latter is being mounted on, or removed from, the die slide 20.

It was mentioned above that the frame sections 16 and 17 are adjustably movable on the ways 14 and 15 to adapt the machine to different workpieces and to the formation of differently spaced bends in the workpiece. Such shifting of the frame sections 16 and 17 can be accomplished by providing the bed portion 12 of the frame with an adjusting screw 132 for each frame section and which cooperates with the threaded opening of a depending bracket 133 carried by the frame section. When the frame sections 16 and 17 have been shifted to the desired adjustment by means of the screws 132, they are thereafter retained at the desired spacing by means of the links 76 and 77 and by the use of any suitable clamping or holding means. It will be understood, of course, that links of a different length are substituted in the machine to suit the adjusted spacing of the frame sections.

From the foregoing description and the accompanying drawings it will now be readily understood that this invention provides a machine for performing multiple bends in an elongated metal workpiece as steps of a single bending operation and that the improved machine carries out this operation with but one clamping of the workpiece and it is unnecessary to shift the workpiece or reclamp the same as has been necessary in the machines heretofore available. It will also be seen that in this improved machine a metal workpiece can be quickly, accurately and economically bent to a desired polygonal cross-sectional shape and that when the workpiece is a longitudinally flanged metal workpiece this bending can be carried out without wrinkling or buckling of the flanges. Additionally, it will be understood that in this improved machine the bending dies are actuated, in part, by swinging main wings and, in part, by swinging auxiliary wings which are carried by the main wings. From the foregoing detailed description it will also be understood that the anvil die unit is contractable to facilitate the removal of the formed workpiece therefrom. Moreover, it will be understood that this improved bending machine provides a bending die member which is adapted for sliding movement relative to a swinging wing by which such bending die is actuated during the bending operation.

Although the improved bending machine has been illustrated and described herein to a somewhat detailed extent, it will be understood, of course, that the invention is not to be regarded as being limited correspondingly in scope, but includes all changes and modifications coming within the terms of the claims hereof.

Having thus described my invention, I claim:

1. In a metal bending machine of the character described, a work support adapted to receive thereon a workpiece to be bent, a die unit embodying a plurality of anvil die members and being movable for bringing one of said anvil die members into work-clamping cooperation with said work support, a wing mounted for swinging movement, a bending die carried by said wing and being rockable thereby around said one anvil die member for bending a portion of said workpiece therearound, a clamping die carried by said wing and being movable thereby into work-clamping cooperation with another of said anvil die members, a second bending die carried by said wing and being rockable around said other anvil die member for bending another portion of said workpiece therearound, mounting means mounting said second bending die on said wing for swinging movement relative thereto for causing the rocking of said second bending die around said other anvil die member, means for imparting said swinging movement to said wing, and a power device of the type adapted to be energized for producing an actuating force and carried by said wing and operably connected with the mounting means for said second bending die for imparting said swinging movement to the latter.

2. In a metal bending machine of the character described, a work supporting die adapted to receive thereon a workpiece having web and flange portions, a die unit embodying a plurality of anvil die members and being movable for bringing one of said anvil die members into work-clamping cooperation with said work support, a wing mounted for swinging movement, a bending die carried by said wing and being rockable thereby around said one anvil die member for forming a first bend in the workpiece at one point thereof by bending the web portion of said work-

piece out of its own plane and simultaneously bending the flange portion within its own plane, said work supporting die and said bending die having angularly disposed portions for holding said flange portion of the workpiece against buckling during the forming of said first bend, a clamping die carried by said wing and being movable thereby into work-clamping cooperation with another of said anvil die members, a second bending die carried by said wing and being rockable around said other anvil die member for forming a second bend in the workpiece at another point thereof by bending said web portion out of its own plane and simultaneously bending said flange portion within its own plane, said clamping die and said second bending die having angularly disposed portions for holding said flange portion of the workpiece against buckling during the forming of said second bend, mounting means mounting said second bending die on said wing for swinging movement relative thereto, means for imparting said swinging movement to said wing, and a power device of the type adapted to be energized for producing an actuating force and carried by said wing and operably connected with the mounting means for said second bending die for imparting said swinging movement to the latter.

3. In a metal bending machine of the character described, a work support adapted to receive thereon a workpiece to be bent, a die unit embodying a plurality of anvil die members including a first pair of anvil die members and a second pair of anvil die members, said die unit being movable for bringing said first pair of anvil die members into work-clamping cooperation with said work support, a pair of wings mounted for swinging movement, bending dies carried by said wings and being rockable thereby around said first pair of anvil die members for bending spaced portions of said workpiece therearound, clamping dies carried by said wings and being movable thereby into work-clamping cooperation with said second pair of anvil die members, second bending dies carried by said wings and being rockable around said second pair of anvil die members for bending other portions of said workpiece therearound, mounting means mounting said second bending dies on said wings for work bending and return swinging movements relative thereto, means for imparting said swinging movement to said wings, and double acting power devices of the type adapted to be energized for producing actuating forces and mounted on said wings and operably connected with the mounting means for said second bending dies for imparting said swinging movements to the latter.

4. In a metal bending machine of the character described, a work support adapted to receive thereon a workpiece to be bent, a die unit embodying a plurality of anvil die members including a first pair of anvil die members and a second pair of anvil die members, said die unit being movable for bringing said first pair of anvil die members into work-clamping cooperation with said work support, a pair of wings mounted for swinging movement, bending dies carried by said wings and being rockable thereby around said first pair of anvil die members for bending spaced portions of said workpiece therearound, clamping dies carried by said wings and being movable thereby into work-clamping cooperation with said second pair of anvil die members, second bending dies carried by said wings and being rockable around said second pair of anvil die members for bending other portions of said workpiece therearound, mounting means mounting said second bending dies on said wings for swinging movement relative thereto and including lever portions, means for imparting said swinging movement to said wings, and pressure fluid responsive power cylinders carried by said wings and operably connected through said lever portions with the mounting means for said second bending dies for imparting said swinging movement to the latter.

5. In a metal bending machine of the character described, work supporting die means adapted to receive thereon a workpiece having web and flange portions, a die unit embodying a plurality of anvil die members including a first pair of anvil die members and a second pair of anvil die members, said die unit being movable for bringing said first pair of anvil die members into engagement with said workpiece at spaced points thereof and into work-clamping cooperation with said work supporting die means, a pair of wings mounted for swinging movement, first bending dies carried by said wings and being rockable thereby around said first pair of anvil die members for forming a pair of initial bends in said workpiece at said spaced points thereof by bending the web portion of the workpiece out of its own plane and simultaneously bending said flange portion within its own plane, said work supporting die means and said first bending dies having angularly disposed portions for holding said flange portion of the workpiece against buckling during the forming of said initial bends, clamping dies carried by said wings and being movable thereby into engagement with said workpiece at other spaced points and into work-clamping engagement with said second pair of anvil die members, second bending dies carried by said wings and being rockable around said second pair of anvil die members for forming other bends in said workpiece at other points thereof by bending said web portion out of its own plane and simultaneously bending said flange portion within its own plane, said clamping dies and said second bending dies having angularly disposed portions for holding said flange portion of the workpiece against buckling during the forming of said other bends, mounting means mounting said second bending dies on said wings for work bending and return swinging movements relative thereto, means for imparting said swinging movement to said wings, and double acting power devices of the type adapted to be energized for producing actuating forces and mounted on said wings and operably connected with the mounting means for said second bending dies for imparting said swinging movements to the latter.

6. In a metal bending machine of the character described, work supporting die means adapted to receive thereon a workpiece having web and flange portions, a die unit embodying a plurality of anvil die members including a first pair of anvil die members and a second pair of anvil die members, said die unit being movable for bringing said first pair of anvil die members into engagement with said workpiece at spaced points thereof and into work-clamping cooperation with said work supporting die means, a pair of wings mounted for swinging movement, first bending dies carried by said wings and being rockable thereby around said first pair of anvil die members for forming a pair of initial bends in said workpiece at said spaced points thereof

by bending the web portion of the workpiece out of its own plane and simultaneously bending said flange portion within its own plane, said work supporting die means and said first bending dies having angularly disposed portions for holding said flange portion of the workpiece against buckling during the forming of said initial bends, clamping dies carried by said wings and being movable thereby into engagement with said workpiece at other spaced points and into work-clamping engagement with said second pair of anvil die members, second bending dies carried by said wings and being rockable around said second pair of anvil die members for forming other bends in said workpiece at other points thereof by bending said web portion out of its own plane and simultaneously bending said flange portion within its own plane, said clamping dies and said second bending dies having angularly disposed portions for holding said flange portion of the workpiece against buckling during the forming of said other bends, mounting means mounting said second bending dies on said wings for work bending and return swinging movements relative thereto, means for imparting said swinging movement to said wings, and double acting fluid pressure responsive power devices carried by said wings and operably connected with the mountings means for said second bending dies for imparting said swinging movement to the latter.

7. In a metal bending machine of the character described, a frame, a work support adapted to receive thereon a workpiece to be bent, a die unit embodying a plurality of anvil die members one of which is adapted for work-clamping cooperation with said work support, a wing mounted for swinging movement, a bending die carried by said wing and being rockable thereby around said one anvil die member for bending a portion of said workpiece therearound, a clamping die carried by said wing and being movable thereby into work-clamping cooperation with another of said anvil die members, a second bending die carried by said wing and being rockable around said other anvil die member for bending another portion of said workpiece therearound, said second bending die being mounted on said wing for swinging movement relative thereto, means for imparting said swinging movement to said wing, means for imparting said swinging movement to said second bending die, a slide on said frame and movable toward and away from said work support, said die unit comprising a carrier connected with said slide and on which said anvil die members are mounted for relative movement for causing expansion and contraction of the die unit, means adapted to impart such movement to said anvil die members, and means anchored on said frame and adapted to apply actuating thrust to the last-mentioned means for expanding said anvil die members in response to movement of the die unit into work-clamping cooperation with said work support and to contract said anvil die members in response to movement of the die unit out of said work-clamping cooperation.

8. In a metal bending machine of the character described, a frame, a work supporting die adapted to receive thereon a workpiece having web and flange portions, a die unit embodying a plurality of anvil die members one of which is adapted for work-clamping cooperation with said work support, a wing mounted for swinging movement, a bending die carried by said wing and being rockable thereby around said one anvil die member for forming a first bend in the workpiece at one point thereof by bending the web portion of said workpiece out of its own plane and simultaneously bending the flange portion within its own plane, said work supporting die and said bending die having angularly disposed portions for holding said flange portion of the workpiece against buckling during the forming of said first bend, a clamping die carried by said wing and being movable thereby into work-clamping cooperation with another of said anvil die members, a second bending die carried by said wing and being rockable around said other anvil die member for forming a second bend in the workpiece at another point thereof by bending said web portion out of its own plane and simultaneously bending said flange portion within its own plane, said clamping die and said second bending die having angularly disposed portions for holding said flange portion of the workpiece against buckling during the forming of said second bend, mounting means mounting said second bending die on said wing for swinging movement relative thereto, means for imparting said swinging movement to said wing, means for imparting said swinging movement to said second bending die, a slide on said frame and movable toward and away from said work supporting die, said die unit comprising a carrier connected with said slide and on which said anvil die members are mounted for relative movement for causing expansion and contraction of the die unit, means for causing such relative movement of said anvil die members, and means anchored on said frame and adapted to apply actuating thrust to the last-mentioned means for expanding and contracting said anvil die members in response to movement of said die unit into and out of work-clamping cooperation with said work supporting die.

9. In a metal bending machine of the character described, a frame, a work supporting die adapted to receive thereon a workpiece having web and flange portions, a die unit embodying a plurality of anvil die members one of which is adapted for work-clamping cooperation with said work support, a wing mounted for swinging movement, a bending die carried by said wing and being rockable thereby around said one anvil die member for forming a first bend in the workpiece at one point thereof by bending the web portion of said workpiece out of its own plane and simultaneously bending the flange portion within its own plane, said work supporting die and said bending die having angularly disposed portions for holding said flange portion of the workpiece against buckling during the forming of said first bend, a clamping die carried by said wing and being movable thereby into work-clamping cooperation with another of said anvil die members, a second bending die carried by said wing and being rockable around said other anvil die member for forming a second bend in the workpiece at another point thereof by bending said web portion out of its own plane and simultaneously bending said flange portion within its own plane, said clamping die and said second bending die having angularly disposed portions for holding said flange portion of the workpiece against buckling during the forming of said second bend, mounting means mounting said second bending die on said wing for swinging movement relative thereto, means for imparting said swinging movement to said wing, a power device carried by said wing and operably connected with the last-mentioned mounting means for imparting said swinging

movement to said second bending die, a slide on said frame and movable toward and away from said work supporting die, said die unit comprising a carrier connected with said slide and on which said anvil die members are mounted for relative movement for causing expansion and contraction of the die unit, means adapted to impart such movement to said anvil die members, and means anchored on said frame and adapted to apply actuating thrust to the last-mentioned means for expanding said anvil die members in response to movement of the die unit into work-clamping cooperation with said work supporting die and to contract said anvil die members in response to movement of the die unit out of said work-clamping cooperation.

10. In a metal bending machine of the character described, a frame, work supporting die means adapted to receive thereon a workpiece having web and flange portions, a die unit embodying a plurality of anvil die members including a first pair of anvil die members adapted for work-clamping cooperation with said work supporting die means and a second pair of anvil die members, a slide operable on said frame and mounting said die unit for movement for bringing said first pair of anvil die members into engagement with said workpiece at spaced points thereof and into work-clamping cooperation with said work supporting die means, a pair of wings mounted for swinging movement, first bending dies carried by said wings and being rockable thereby around said first pair of anvil die members for forming a pair of initial bends in said workpiece at said spaced points thereof by bending the web portion of the workpiece out of its own plane and simultaneously bending said flange portion within its own plane, said work supporting die means and said first bending dies having angularly disposed portions for holding said flange portion of the workpiece against buckling during the forming of said initial bends, clamping dies carried by said wings and being movable thereby into engagement with said workpiece at other spaced points and into work-clamping cooperation with said second pair of anvil die members, second bending dies carried by said wings and being rockable around said second pair of anvil die members for forming other bends in said workpiece at other points thereof by bending said web portion out of its own plane and simultaneously bending said flange portion within its own plane, said clamping dies and said second bending dies having angularly disposed portions for holding said flange portion of the workpiece against buckling during the forming of said other bends, means mounting said second bending dies on said wings for swinging movement relative thereto, means for imparting said swinging movement to said wings, power devices mounted on said wings and operably connected with the last-mentioned mounting means for imparting said swinging movement to said second bending dies, said die unit comprising a carrier connected with said slide and on which said anvil die members are mounted for relative movement for causing expansion and contraction of the die unit, means adapted to move said anvil die members in a direction to expand or contract said die unit, and means anchored on said frame and adapted to apply actuating thrust to the last-mentioned means for expanding and contracting said anvil die members in response to movement of said die unit into and out of work-clamping cooperation with said work supporting die means.

11. In a metal bending machine of the character described, a frame, a work support on said frame and adapted to receive thereon a workpiece to be bent, a die unit embodying a plurality of anvil die members and being movable on said frame for bringing one of said anvil die members into work-clamping cooperation with said work support, a wing pivoted on said frame for swinging movement relative to said die unit, gear sectors on said frame and located substantially on the axis of the wing pivot, a die plate having a bending die thereon and adapted to be actuated by said wing to cause rocking of said bending die around said one anvil die member for bending said workpiece therearound, racks on said die plate meshing with said gear sectors, a pressure roller carried by said wing and acting on said plate in a direction to retain said racks and gear sectors in mesh, clamping die means carried by said wing and being movable thereby into work-clamping engagement with another of said anvil die members, a second die plate, a second bending die carried by said second die plate and being movable thereon, means pivotally mounting said second die plate on said wing and adapting said second die plate to cause rocking of said second bending die around said other anvil die member for bending another portion of said workpiece around the latter, other gear sectors carried by said wing and located substantially on the pivot axis of said second die plate, racks connected with said second bending die and meshing with said other gear sectors, means for imparting said swinging movement to said wing, and means for imparting said swinging movement to said second die plate.

12. A bending machine of the character described comprising, a frame having a work support adapted to receive thereon a workpiece to be bent, anvil die means adapted for work-clamping cooperation with said work support, a main wing pivoted on said frame for swinging movement, a bending die rockable around said anvil die means by the swinging of said main wing for bending a portion of said workpiece around said anvil die means, means for imparting said swinging movement to said main wing, an auxiliary wing carried by said main wing and pivotally connected therewith for swinging movement relative thereto, a second bending die carried by said auxiliary wing and being rockable around said anvil die means by the swinging of said auxiliary wing for bending another portion of the workpiece around said anvil die means, and a double acting power device of the type adapted to be energized for producing actuating forces and mounted on said main wing and operably connected with said auxiliary wing for imparting swinging movements to the latter.

13. A bending machine of the character described comprising, a frame having a clamping die adapted to receive thereon a workpiece having web and flange portions, anvil die means adapted for work-clamping cooperation with said clamping die, a main wing pivoted on said frame for swinging movement, a bending die rockable around said anvil die means by the swinging of said main wing for bending a portion of said workpiece around said anvil die means by bending said web portion out of its own plane and simultaneously bending said flange portion within its own plane, means for imparting said swinging movement to said main wing, said clamping die and said bending die having angularly disposed portions for holding said flange portion of

the workpiece against buckling during the bending thereof, a second clamping die carried by said main wing and adapted for work-clamping cooperation with said anvil die means, an auxiliary wing carried by said main wing and pivotally connected therewith for swinging movement relative thereto, a second bending die carried by said auxiliary wing and being rockable around said anvil die means by the swinging of said auxiliary wing for forming a second bend in the workpiece by bending the web portion thereof out of its own plane and simultaneously bending said flange portion within its own plane, said second clamping die and said second bending die having angularly disposed portions for holding said flange portion of the workpiece against buckling during the forming of said second bend, and a power device of the double acting pressure fluid responsive cylinder type mounted on said main wing and operably connected with said auxiliary wing for imparting swinging movements to the latter.

14. A bending machine of the character described comprising, a frame having a work support adapted to receive thereon a workpiece to be bent, anvil die means adapted for work clamping cooperation on said work support, a pair of main wings pivoted on said frame for swinging movement toward said anvil die means from opposite sides thereof, bending dies rockable around said anvil die means by the swinging of said main wings for bending different portions of said workpiece around said anvil die means, means for imparting said swinging movement to said main wings, auxiliary wings carried by said main wings and pivotally connected therewith for swinging movement toward said anvil die means, other bending dies carried by said auxiliary wings and being rockable around said anvil die means by the swinging of said auxiliary wings for bending other portions of the workpiece around said anvil die means, and double acting power devices of the type adapted to be energized for producing actuating forces and mounted on said main wings and operably connected with said auxiliary wings for imparting swinging movements to the latter.

15. A bending machine of the character described comprising, a frame having a work support adapted to receive thereon a workpiece to be bent, anvil die means adapted for work clamping cooperation with said work support, a main wing pivoted on said frame for swinging movement, a bending die rockable around said anvil die means by the swinging of said main wing for bending a portion of said workpiece around said anvil die means, means for imparting said swinging movement to said main wing, said main wing having ways formed thereon, a clamping die carrier mounted on said main wing and being adjustable thereon along said ways, a clamping die on said clamping die carrier and being movable into work-clamping cooperation with said anvil die means by said swinging of the main wing, an auxiliary wing pivotally connected with said clamping die carrier for swinging movement relative to said main wing, a second bending die carried by said auxiliary wing and being rockable around said anvil die means by the swinging of said auxiliary wing for bending another portion of the workpiece around said anvil die means, and a power device mounted on said main wing and operably connected with said auxiliary wing for imparting said swinging movement to the latter.

16. A bending machine of the character described comprising, a frame having a work support adapted to receive thereon a workpiece to be bent, anvil die means adapted for work clamping cooperation with said work support, a main wing pivoted on said frame for swinging movement, a bending die rockable around said anvil die means by the swinging of said main wing for bending a portion of said workpiece around said anvil die means, arcuate gear elements on said frame, racks connected with said bending die and meshing with said arcuate gear elements, means for imparting said swinging movement to said main wing, said main wing having ways thereon, a clamping die carrier on said main wing and adjustable to different positions along said ways, a clamping die mounted on said clamping die carrier and movable to work-clamping cooperation with said anvil die means by said swinging of said main wing, an auxiliary wing pivotally connected with said clamping die carrier and adapted for swinging movement relative to said main wing, a second bending die carried by said auxiliary wing and being rockable around said anvil die means by the swinging of said auxiliary wing for bending another portion of the workpiece around said anvil die means, arcuate gear elements on said clamping die carrier, racks connected with said second bending die and meshing with the arcuate gear elements of said clamping die carrier, and a power device mounted on said main wing and operably connected with said auxiliary wing for imparting said swinging movement to the latter.

17. A bending machine of the character described comprising, a frame having a work support adapted to receive thereon a workpiece to be bent, anvil die means adapted for work clamping cooperation with said work support, a main wing pivoted on said frame for swinging movement, a bending die rockable around said anvil die means by the swinging of said main wing for bending a portion of said workpiece around said anvil die means, means for imparting said swinging movement to said main wing, an auxiliary wing carried by said main wing and pivotally connected therewith for swinging movement relative thereto, a second bending die carried by said auxiliary wing and being rockable around said anvil die means by the swinging of said auxiliary wing for bending another portion of the workpiece around said anvil die means, bearing means mounting said second bending die on said auxiliary wing for sliding movement relative thereto during said swinging movement of said auxiliary wing, and a power device mounted on said main wing and operably connected with said auxiliary wing for imparting said swinging movement to the latter.

18. In a bending machine, a frame having a work support adapted to receive thereon a workpiece to be bent, an anvil die means movable to and from work-clamping cooperation with said work support, a pair of main wings pivoted on said frame for swinging movement toward said anvil die means from opposite sides thereof, a pair of auxiliary wings pivotally connected with said main wings and adapted for swinging movement toward said anvil die means, bending dies carried by said main wings and said auxiliary wings and adapted to be actuated thereby for bending different portions of said workpiece around the anvil die means, said anvil die means being expandable during movement thereof toward its work-clamping position and being contractable during movement thereof away from its work-clamping position to permit removal of the

bent workpiece, means for causing such expansion and contraction of said anvil die means, power means for actuating said main wings, and double acting power devices of the type adapted to be energized for producing actuating forces and mounted on said main wings and operably connected with said auxiliary wings for actuating the latter.

19. In a bending machine, a frame having a work support adapted to receive thereon a workpiece to be bent, an anvil die means of substantially polygonal shape movable relative to said work support for moving one side of the anvil die means into and out of work-clamping cooperation with said work support, a pair of main wings pivoted on said frame for swinging movement toward each other and toward said anvil die means from opposite sides of the latter, a pair of auxiliary wings pivotally connected with said main wings and adapted for swinging movement toward the side of said anvil die means which is opposed to the side having said work-clamping cooperation with said support, bending dies carried by said main wings and said auxiliary wings and adapted to be actuated thereby for bending different portions of said workpiece around the anvil die means to cause said workpiece to assume the polygonal shape of said anvil die means, bearing means mounting certain of said bending dies on said auxiliary wings for sliding movement relative thereto during the bending of said workpiece, said anvil die means being contractable during movement thereof away from its work-clamping position to permit removal of the polygonally formed workpiece therefrom, means for causing such contraction of said anvil die means, power means for actuating said main wings, and power devices mounted on said main wings and operably connected with said auxiliary wings for actuating the latter.

20. In a metal bending machine of the character described, a frame, a work support on said frame and adapted to receive thereon a workpiece to be bent, a die unit embodying a plurality of anvil die members and being movable on said frame for bringing one of said anvil die members into work-clamping cooperation with said work support, a wing pivoted on said frame for swinging movement relative to said die unit, gear sectors on said frame and located substantially on the axis of the wing pivot, a die plate having a bending die thereon and adapted to be actuated by said wing to cause rocking of said bending die around said one anvil die member for bending said workpiece therearound, racks on said die plate meshing with said gear sectors, a pressure

roller carried by said wing and acting on said plate in a direction to retain said racks and gear sectors in mesh, clamping die means carried by said wing and being movable thereby into work-clamping engagement with another of said anvil die members, a second die plate, a second bending die carried by said second die plate and being movable thereon, means pivotally mounting said second die plate on said wing and adapting said second die plate to cause rocking of said second bending die around said other anvil die member for bending another portion of said workpiece around the latter, other gear sectors carried by said wing and located substantially on the pivot axis of said second die plate, racks connected with said second bending die and meshing with said other gear sectors, means for imparting said swinging movement to said wing, means for imparting said swinging movement to said second die plate, said die unit comprising a carrier on which said anvil die members are mounted for relative movement for causing expansion and contraction of the die unit, and means adapted to move said anvil die members in a direction to expand said die unit in response to movement of the die unit into work-clamping cooperation with said work support and to move said anvil die members in a direction to contract said die unit in response to movement of the die unit out of said work-clamping cooperation.

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