

May 8, 1962

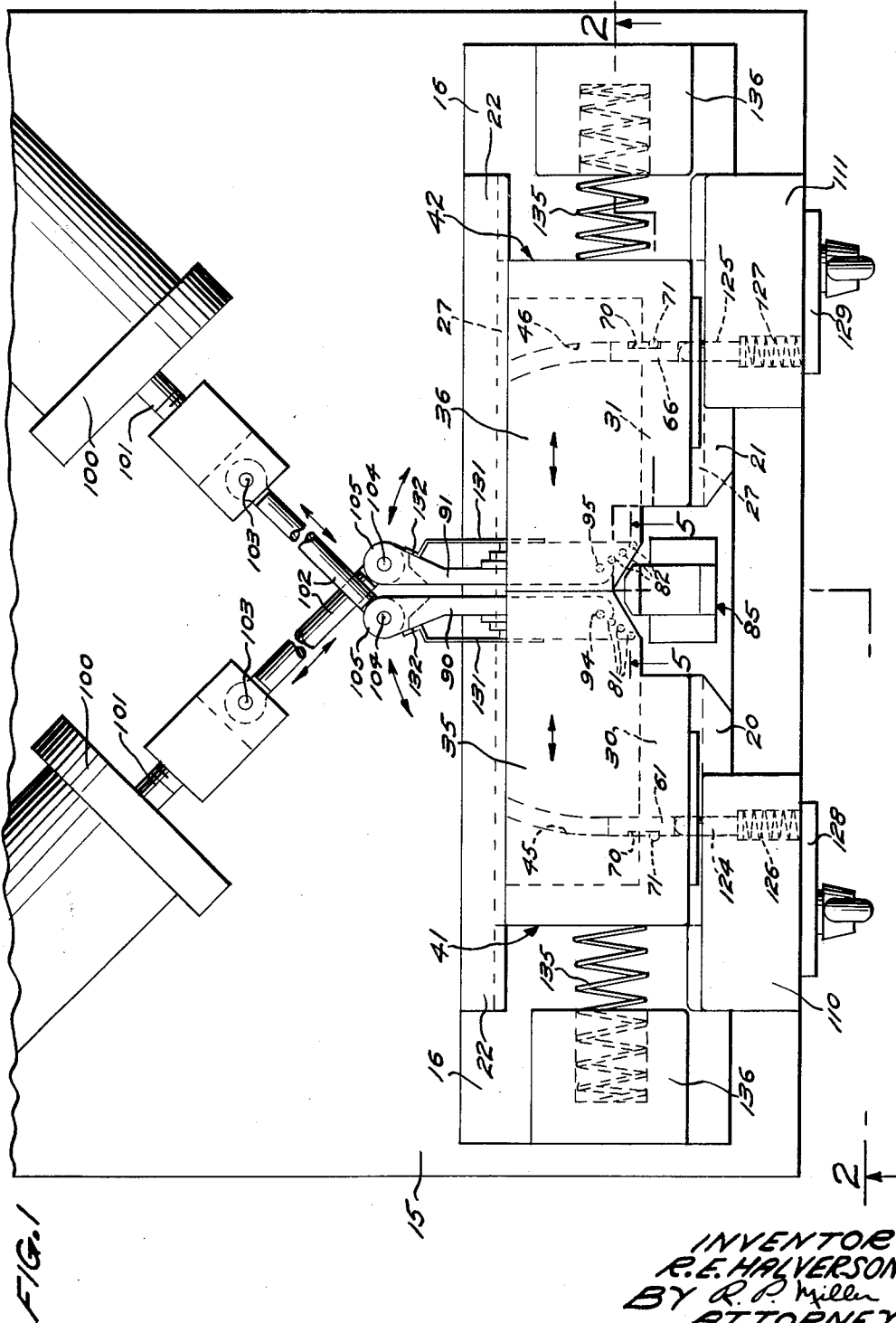
R. E. HALVERSON

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DEVICE FOR BENDING TERMINALS

Filed Sept. 25, 1958

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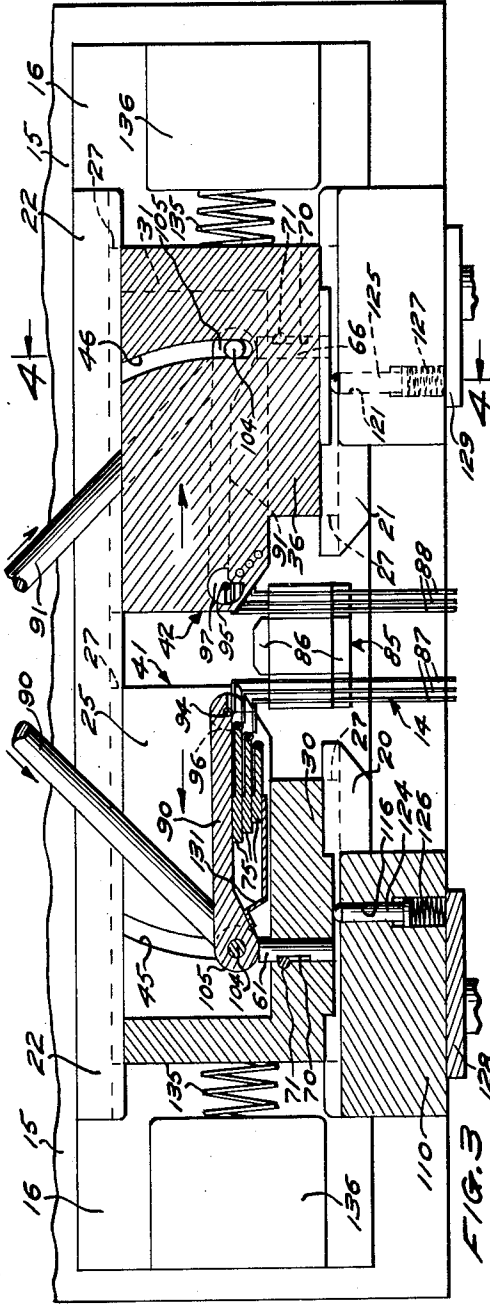
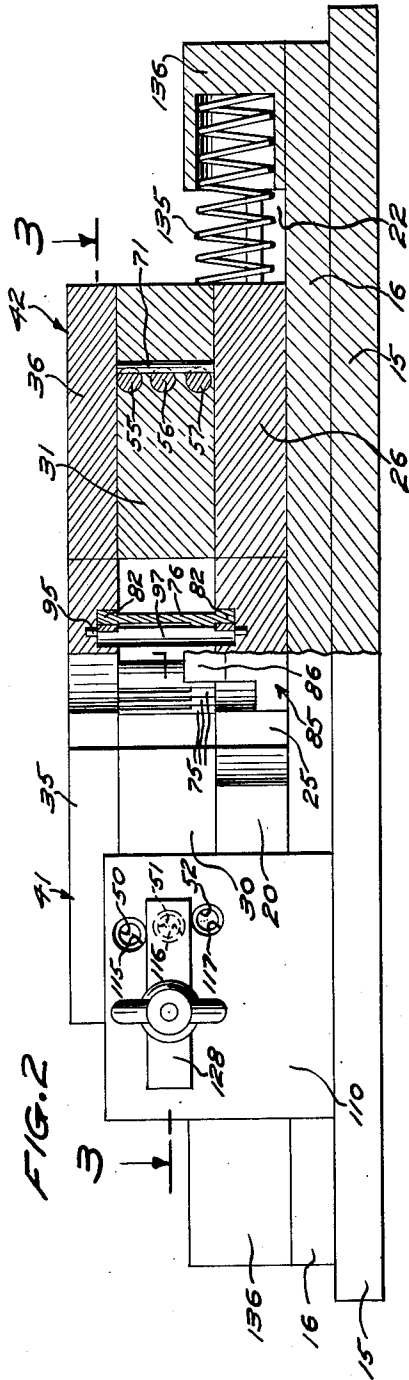
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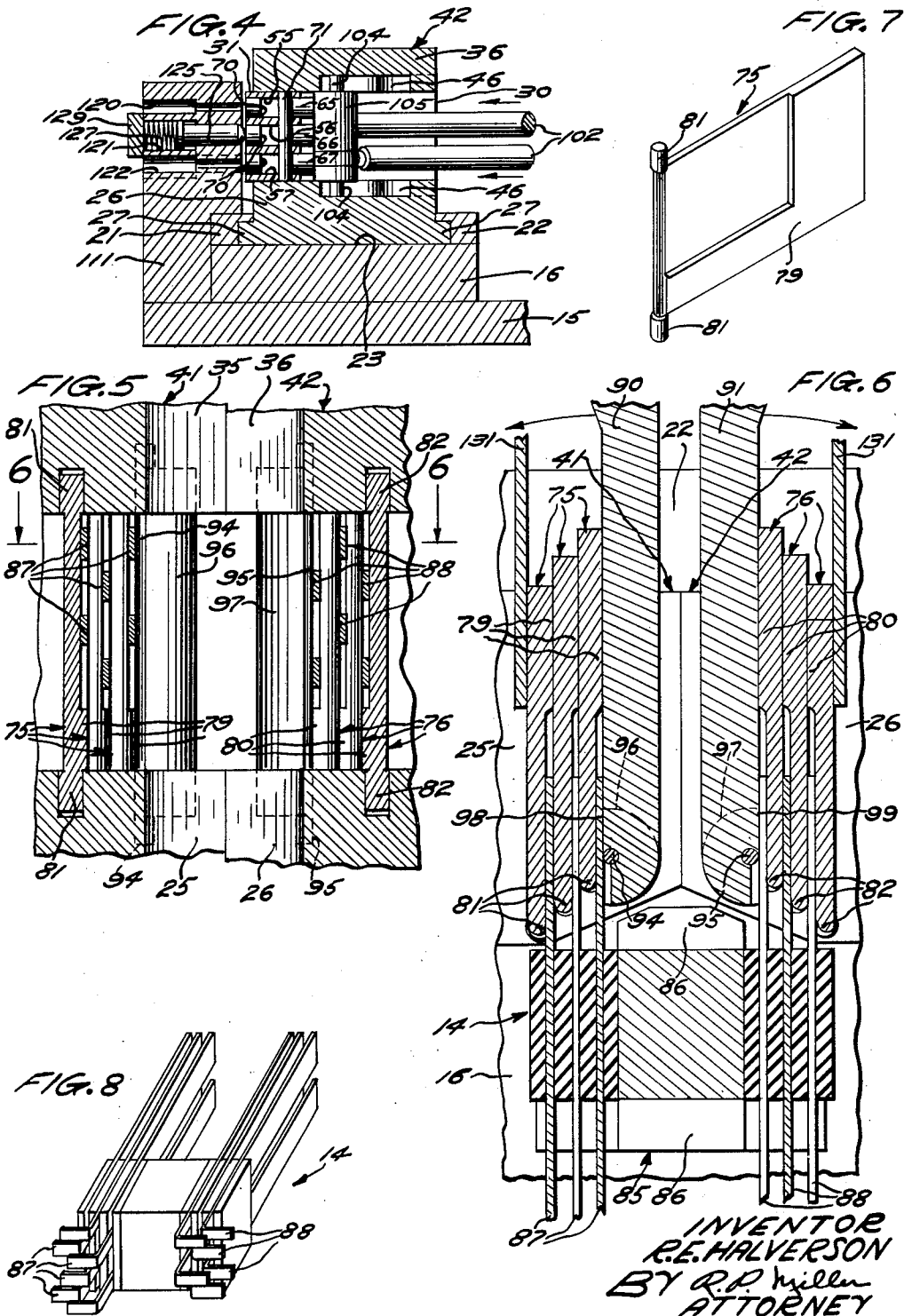
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DEVICE FOR BENDING TERMINALS

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3,033,265

## DEVICE FOR BENDING TERMINALS

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12 Claims. (Cl. 153-16)

This invention relates to a device for bending terminals and more particularly to the apparatus for bending terminals in different planes on a terminal assembly.

In the fabrication of certain terminal assemblies it is necessary to bend the terminals in different planes. In the past this was done by separately bending each terminal individually in a bending device. Procedures of this sort result in irregularities in successively produced terminal assemblies with corresponding reductions in strength and dependability of the terminal assemblies. It is therefore extremely important to be able to automatically and simultaneously bend terminals of a terminal assembly quickly and accurately with a high degree of dependability to produce a high quality terminal assembly having individual terminals positioned in different planes.

It is the primary object of this invention to provide an apparatus of simple and economical construction for automatically bending terminals on a terminal assembly.

Another object of the invention resides in terminal bending elements which are automatically retracted from the bent terminals upon completion of the bending of the terminals.

Another object of the invention is to provide an apparatus which will provide automatic terminal bending elements that retract from the assembly automatically by a single movement of a drive member.

A further object of the invention is to provide a nesting arrangement to conveniently hold a terminal assembly between terminal bending elements to position the terminals within the confines of a bank of stacked bending elements.

An additional object of the invention is to provide an apparatus for automatically bending terminals of terminal assemblies of different sizes and having a varied arrangement of terminals.

With these and other objects in view, the present invention contemplates a nest for holding a terminal assembly together with a series of forming elements for engaging and automatically bending terminals extending from the assembly. The apparatus also includes facilities for automatically retracting the forming elements to allow removal of the assembly.

Other objects and advantages of the invention will become apparent by reference to the following detailed description and the accompanying drawings wherein:

FIG. 1 is a top plan view of a bending apparatus illustrating the movement of a series of bending elements and the actuating mechanism therefor embodying the principles of the present invention;

FIG. 2 is a sectional view taken along lines 2-2 of FIG. 1 showing the bending elements in a retracted position to receive a terminal assembly;

FIG. 3 is a sectional view taken along lines 3-3 of FIG. 2 showing a terminal assembly positioned within the bending apparatus with the terminals bent and with the terminal bending elements retracted;

FIG. 4 is a sectional view taken along lines 4-4 of FIG. 3 illustrating a release mechanism for changing the movement of the bending elements from a bending movement to an outward retraction movement;

FIG. 5 is a fragmentary sectional view taken along lines 5-5 of FIG. 1 showing the terminals of a terminal

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assembly in position between the bending elements of the bending apparatus;

FIG. 6 is a fragmentary view taken along lines 6-6 of FIG. 5 showing the terminal assembly nested in the apparatus with terminals inserted between bending elements prior to bending;

FIG. 7 is a perspective view of a bending plate showing the relieved portion therein to receive a terminal to be bent; and

FIG. 8 is a perspective view of a terminal assembly after the terminals have been bent by the apparatus shown in the figures.

Referring to the drawings there is illustrated a bending apparatus (FIGS. 1-3) for a terminal assembly 14, having a base 15 with a base plate 16 rigidly secured thereto. A channel 23 is provided on base plate 16 by guide members 20, 21 and 22 (FIGS. 1 and 4). A pair of frames 25 and 26 having flanges 27 thereon are slidably fitted within the channel 23 formed by guide members 20-22 to move toward and away from each other. Frames 25 and 26 have two L-shaped spacing members 30 and 31 and a pair of top frames 35 and 36 respectively rigidly secured thereto in stacked relation (FIGS. 2 and 4) to provide a pair of slide assemblies generally designated by the reference numerals 41 and 42.

The frames 25 and 26 and the top frames 35 and 36 have aligned pairs of guide grooves 45 and 46 respectively. The spacing members 30 and 31 each have three cylindrical passages 50-52 and 55-57 formed therein. Two sets of cylindrical pins 60-62 and 65-67 are slidably mounted in the cylindrical passages 50-52 and 55-57 respectively. Each of the cylindrical pins 60-62 and 65-67 (FIGS. 1 and 4) has a relieved portion 70 through which passes a pin 71 that is secured to the base plates 25 and 26 and top plates 35 and 36. The sliding movement of the relieved pins 60-62 and 65-67 is thus limited by the length of the relieved portions 70 in engagement with the pins 71.

Two groups of parallel bending plates 75 and 76 having L-shaped raised portions 79 and 80 (FIG. 7), are pivotally mounted to and between the frames 25 and 26 and top frames 35 and 36 at 81 and 82 (FIGS. 1, 2, 3, 5 and 6). A nest 85, secured to the base 16, has a pair of locating projections extending therefrom to receive and hold a terminal assembly 14. Two sets of terminals 87 and 88 extending from the assembly 14 are thus positioned between respective sets of parallel bending plates 75 and 76 (FIGS. 5 and 6).

A pair of bending levers 90 and 91 are pivotally mounted between the bottom frames 25 and 26 and the top frames 35 and 36 on a pair of vertical shafts 94 and 95 respectively. Semi-cylindrical portions 96 and 97 are formed on the ends of bending elements 90 and 91 around the vertical shafts 94 and 95 and provide surfaces 98 and 99 in engagement with the respective innermost terminals of the groups of terminals 87 and 88 (FIG. 6). A pair of air cylinders 100 secured to base 15 have piston rods 101 pivotally linked to the outer ends of the bending members 90 and 91 at 103 and 104 by a pair of links 102 connected to the rods 101.

A pair of projections 110 and 111 (FIGS. 1, 2, 3 and 4) extend vertically from the frame 15. The projections 110 and 111 each have a set of three counterbored holes 115-117 and 120-122 formed therein. The counterbored holes 115-117 and 120-122 of each set are formed in a vertically stepped relationship. The sets of counterbored holes are separately horizontally aligned with the respective passages 50-53 and 55-57. The holes 115-117 and 120-122 can be aligned with the respective openings in the group of openings 50-53 and 55-57 by moving the members 30 and 31 horizontally. The center holes 116 and 121 of the left and right groups of holes (FIGS.

2 and 4) are shown as being aligned with pins 61 and 66 (see FIG. 1).

A pair of pins 124 and 125 (FIGS. 3 and 4) are selectively placed in the counterbored holes 116 and 121 and project into cylindrical passages 51 and 56 in the L-shaped members 30 or 31 to horizontally position the frames 25 and 26 secured to the L-shaped members. Pins 124 and 125 are shown in the center counterbored holes 116 and 121 and are biased into the center cylindrical passages 51 and 56 by a pair of springs 126 and 127 respectively. The relieved pins 61 and 66 will be forced inwardly allowing the spring biased pins 124 and 125 to enter into the passages 51 and 56 in the L-shaped members 30 and 31 respectively. The pins 124 and 125 thus lock the members 30 and 31 to the projections 110 and 111 respectively. The bottom and top frames 25, 26, 35 and 36, with their sets of bending plates 75 and 76 pivotally secured thereto, are fixed at a specific spaced distance apart as determined by the selection of the center counterbored holes 116 and 121. The compression springs 126 and 127 are held in the counterbores by clamps 128 and 129 which in turn are held in place by wing nuts (FIGS. 1-3).

The distance between the pins 94 and 95 and the pins 104 is equal to the radial distance between the pins 94 and 95 and the arc of the pairs of the respective grooves 45 and 46 on the inner surfaces of the bottom and top frames 25, 26, 35 and 36, respectively. A set of leaf springs 131 are rigidly secured at the outer ends thereof at 132 on the bending elements 90 and 91 and project along the outer surface of the outermost bending plates of the sets of bending plates 81 and 82 (FIGS. 1 and 6). These springs 131 keep the bending plates 75 and 76 in tightly stacked and slidable relationship to each other and to the bending elements 90 and 91 respectively.

#### Operation

In operation, to bend terminals of a terminal assembly in different planes, a terminal assembly 14 is placed in the nest 85 (FIG. 2) with the terminals thereof projecting between bending plates 75 and 76 (FIGS. 5 and 6). The air cylinders 100 are actuated to force rods 101 and links 102 downwardly in a direction indicated by the arrows in FIG. 1. As the downward motion of links 102 continues, members 90 and 91 are pivoted outwardly about the pins 94 and 95 respectively in opposite directions. Bending plates 75 and 76 are consequently pivotally moved with bending members 90 and 91 respectively about points 81 and 82 in sliding stacked relationship with each other. The springs 131, secured to bending members 90 and 91, hold the plates 75 and 76 in stacked relationship during the bending operation.

After the terminals 87 and 88 are so bent about points 81 and 82 respectively, the end portions 105 of members 90 and 91 will engage the pins 61 and 66 to depress the spring biased pins 124 and 125 inserted in projections 110 and 111 and projecting into members 30 and 31 respectively. Continued bending movement of members 90 and 91 cause the pins 124 and 125 to move out of the cylindrical passages 51 and 56 respectively to the extent that the spacing members 30 and 31 are unlocked and are free to move relative to projections 110 and 111. The continued motion of members 90 and 91 also completes the bending of the terminals. The pins 125 and 126 are shown in the center counterbore openings 116 and 121 respectively which positions the bottom and top frames 26 and 36 and spacing elements 30 and 31 respectively at an intermediate spaced apart position to receive a terminal assembly having terminals 87 and 88 correspondingly spaced apart.

The continued application of force by the piston rods 101, through links 102 and pins 104 against the outer surface of the pairs of arcuate grooves 45 and 46, moves the unlocked slide assemblies 41 and 42 away from the terminal assembly 14 in the path determined by the guide members 20-22. This outward movement of the slide

assemblies will act to compress the springs 135 (FIGS. 1-3) inserted in projections 136 of base 16 and remove the bending elements from engagement with the bent terminals. The outward movement of bending plates 75 and 76 is limited by the length of the stroke of the piston rods 101. In this position the terminal assembly with bent terminals is readily removed from nest 85.

Upon removal of the terminal assembly, cylinders 100 are actuated to move rods 101 upwardly as indicated in FIG. 1 to move links 102 and slide assemblies 41 and 42 towards the nest in cooperation with the compressed compression springs 135. Upon a predetermined return movement of the opposing slide assemblies 41 and 42, the pins 124 and 125 will be forced into locking position in the aligned cylindrical passages 51 and 56. Upon a continued retraction movement of the rods 101 and links 102 the bending elements 90 and 91 are rotated toward each other about the pins 94 and 95 and into the original vertical position as shown in FIG. 1. At this point the apparatus is ready for insertion of another assembly element in the nest 85 with the terminals inserted between the bending plates 75 and 76 in readiness for another bending cycle.

It is to be understood that the above-described arrangements are simply illustrative of the application of the principles of this invention. Numerous other arrangements may be readily devised by those skilled in the art which will embody the principles of the invention and fall within the spirit and scope thereof.

What is claimed is:

1. A bending apparatus comprising a slide, a bending member pivotally mounted on the slide, a stack of bending plates pivotally mounted on the slide, one of said plates engaging said bending member, resilient means urging the plates toward the bending member so that said one plate is maintained in engagement with the bending member, said plates being recessed to accommodate a series of elements to be bent, and means for pivoting the bending member to pivot the plates and to bend the elements in the recesses thereof.

2. A bending apparatus comprising a slidably mounted frame, a plurality of parallel bending plates pivotally mounted in said frame, bending means pivotally mounted on the frame adjacent one of the plates, said frame having a series of spaced passages formed therein, said plurality of plates abutting one another so that the pivoting of one of said plates causes the remaining of said plates to pivot, locking means selectively positioned in said passages to hold the frame from movement, means for pivoting the bending means for pivoting said plates to bending position, and means operated by the pivoting of the bending means for releasing the locking means.

3. A device for bending terminals of a terminal assembly comprising a base, a terminal assembly positioning means rigidly mounted on the base, a pair of frames slidably mounted on the base and movable laterally with respect to the terminals of a positioned terminal assembly between a bending position and a retracted position, a set of parallel bending plates pivotally mounted on each frame in sliding stacked relation, said plates having recessed portions adapted to receive a group of terminals of the terminal assembly, bending means pivotally mounted to each frame for pivoting said sets of plates, means for locking the frames to the base, locking release means in the path of the bending means, and actuating means to pivot the bending means to pivot said plates to bending position and to move the bending means against the release means to release the locking means and move the frames to their retracted position.

4. A device for bending terminals of a terminal assembly comprising a base, a nest rigidly mounted on the base for positioning a terminal assembly, a pair of frames slidably mounted to said base and movable from original positions laterally with respect to the terminals of a positioned assembly, lock means to hold the frames from moving laterally, a set of parallel bending plates pivotally

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mounted in each frame and perpendicular to the lateral path of the frames, a bending link pivotally mounted on each frame on an axis parallel to the axes of the plates and in sliding contact with the innermost plate of the respective sets of plates, said bending links pivotally mounted to pivot said plates to bending position and to engage and release the frame locking means upon a predetermined movement of the bending links, reciprocating actuating means for moving the bending links beyond the predetermined distance to slidably move the frames, and spring means for urging the frames to return to the original positions.

5. A device for bending terminals of a terminal assembly comprising a base, a nest for holding an assembly having terminals extending therefrom, a pair of frames slidably mounted on the base to move laterally to the terminals of a nested assembly between bending and retracting positions, parallel bending plates pivotally mounted in the frames in slidably stacked relation, bending means pivotally mounted in each frame adjacent the bending plates, said frames having guide means to confine the bending means during movement thereof, locking means to hold the frames in the bending positions, lock release mechanisms mounted on the respective frames in the path of the bending means, reciprocating means to pivot said bending means to move said plates to bend the terminals of a nested assembly and to actuate said frame release means, said reciprocating moving means adapted to move the frames to the retracted positions when said lock release is actuated, and spring means to return the frames to the bending positions when the reciprocating means is reversed.

6. A device for bending terminals of a terminal assembly comprising a channeled base, a base frame slidably mounted in the channeled base, a spacing member rigidly secured to said base frame, a top frame rigidly secured to said spacing member, said base and top frames having aligned arcuate grooves in their inner surfaces, a plurality of parallel bending plates pivotally mounted between the frames in sliding engagement with each other, said bending plates having relieved portions therein, a nest rigidly mounted on the channeled base to position the terminal assembly with the terminals within the relieved portions of the bending plates, a bending lever in sliding engagement with an innermost bending plate and pivotally mounted to the base and top frames at the center of radius of the arcuate grooves, means to pivot the bending lever to move the bending plates to bend the terminals, pin means on the bending lever to guide the bending lever in the grooves, a resilient holding means in the channeled base in the path of the grooves engaging the base frame to hold the base frame in bending position, means engaged by the lever mounted pin means within the grooves for releasing the resilient holding means.

7. In a bending apparatus for bending a terminal assembly in different planes, the combination comprising a slide, a plurality of parallel bending plates pivotally mounted on the slide, said plurality of plates abutting one another so that the pivoting of one of said plates causes the remaining of said plates to pivot, means for locking the slide against movement, a bending lever in engagement with one of the bending plates, means for actuating the bending lever to pivot the bending plates to bent position, means for prohibiting pivotal movement of the bending plates beyond the bent position, and means actuated by the movement of the bending lever to the bent position for engaging and releasing the locking means whereby a force applied to the actuating means and having a component in the direction of movement of said slide may cause movement of said slide.

8. In a bending apparatus for bending a terminal assembly in different planes, the combination comprising a grooved frame, a plurality of bending plates pivotally mounted in said frame, said plurality of plates abutting one another so that the pivoting of one of said plates

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causes the remaining of said plates to pivot, a bending lever pivoted in said frame and in sliding engagement with the innermost bending plate, means on said lever engaging the groove in said frame, and means to actuate said lever to follow the groove in said frame and to pivot said plates to bending position.

9. In a bending apparatus for bending a terminal assembly, the combination which comprises a pair of grooved frames, a plurality of parallel bending plates mounted in each of said frames in parallel sliding contact, said plates having relieved portions to receive the members to be bent, a pair of bending levers each of which is pivoted in one of said frames and in sliding engagement with the innermost bending plate of said plates in the associated frame, means on each of said levers engaging the groove in said associated frame, and means to actuate said levers to follow the groove in the associated frame and to pivot said plates to bending position to bend the members.

10. A bending apparatus for bending a plurality of members, comprising at least three pivotally mounted, parallel bending plates having their surfaces in generally facing relationship, said plates being pivotable as a unit about independent parallel axes near adjacent ends thereof from a work receiving position through a prescribed angle of bend and having bending edges extending parallel to said axes at the pivoted ends thereof, said axes lying in a plane angularly displaced with respect to a plane perpendicular to said plates when said plates are in the work receiving position, said plates being arranged to receive the members to be bent therebetween at the pivoted ends thereof, and means for pivoting said bending plates to bend the members about the bending edges.

11. A bending apparatus for bending a plurality of members through a prescribed angle, comprising at least three pivotally mounted, parallel bending plates having their surfaces in generally facing relationship, said plates being pivotable as a unit about independent parallel axes near adjacent ends thereof and having bending edges extending parallel to said axes at the pivoted ends thereof, said axes lying in a plane perpendicular to a plane bisecting the prescribed angle of bend, said plates being arranged to receive the members to be bent therebetween at the pivoted ends thereof, and means for pivoting said bending plates to bend the members about the bending edges.

12. A bending apparatus for bending a plurality of members, comprising at least three pivotally mounted, parallel bending plates having their surfaces in generally facing relationship, said plates being pivotable as a unit about independent parallel axes near adjacent ends thereof from a work receiving position through a prescribed angle of bend and having bending edges extending parallel to said axes at the pivoted ends thereof, said axes lying in a plane angularly displaced with respect to a plane perpendicular to said plates when said plates are in the work receiving position, said plates being arranged in engagement and being recessed to receive the members to be bent therebetween at the pivoted ends thereof, and means for pivoting said bending plates to bend the members about the bending edges.

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