United States Patent

Kowal

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[54] **TUBE BENDER**

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[52] **U.S. Cl.** **72/319,** 72/217, 72/459

[51] **Int. Cl.** **B21d 11/04**

[58] **Field of Search**.....72/159, 217, 319, 459

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[57] **ABSTRACT**

A tube bender having a mandrel provided with a groove. A shoe is swingably mounted in association with the mandrel to move around the groove and press a tube thereinto to effect a desired bend. A hook is fixedly associated with the mandrel to limit movement of the tube during the bending operation. The tool is constructed to permit the lateral movement of the tube into association with the hook and mandrel in a bend start position.

15 Claims, 8 Drawing Figures

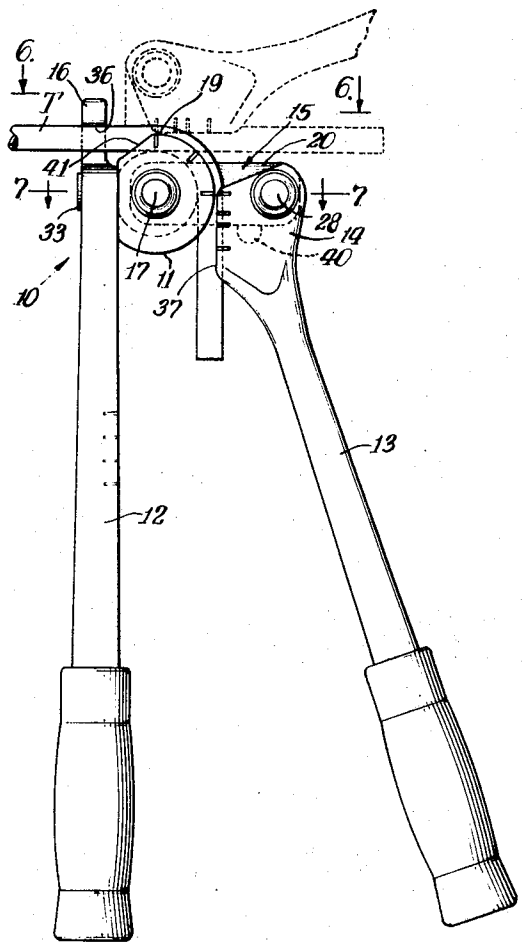

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Fig. 1.

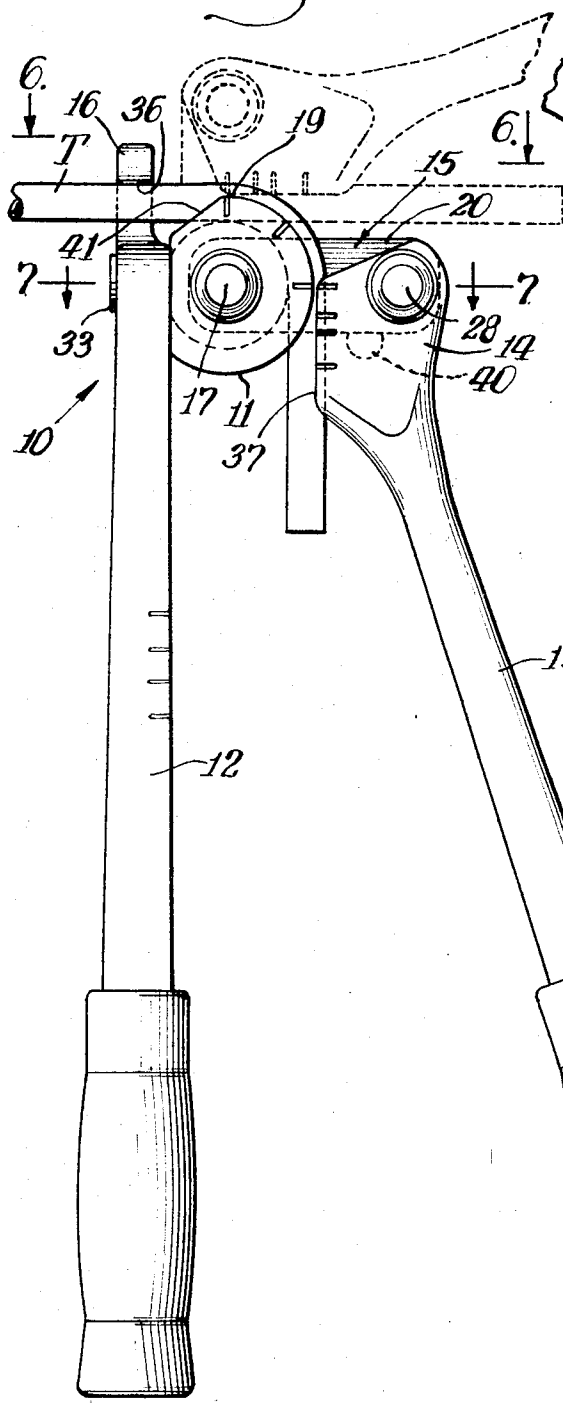


Fig. 2.

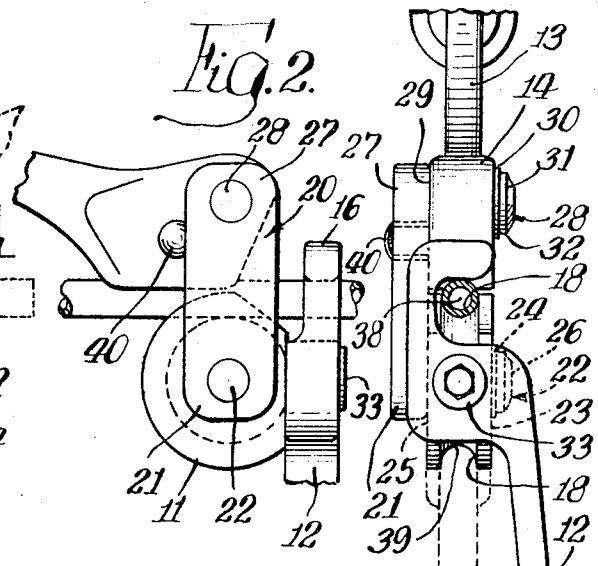
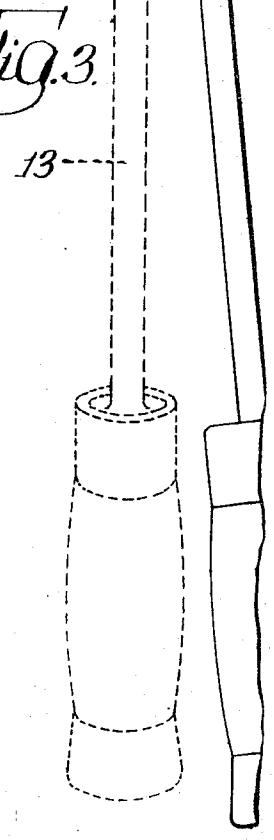


Fig. 3.



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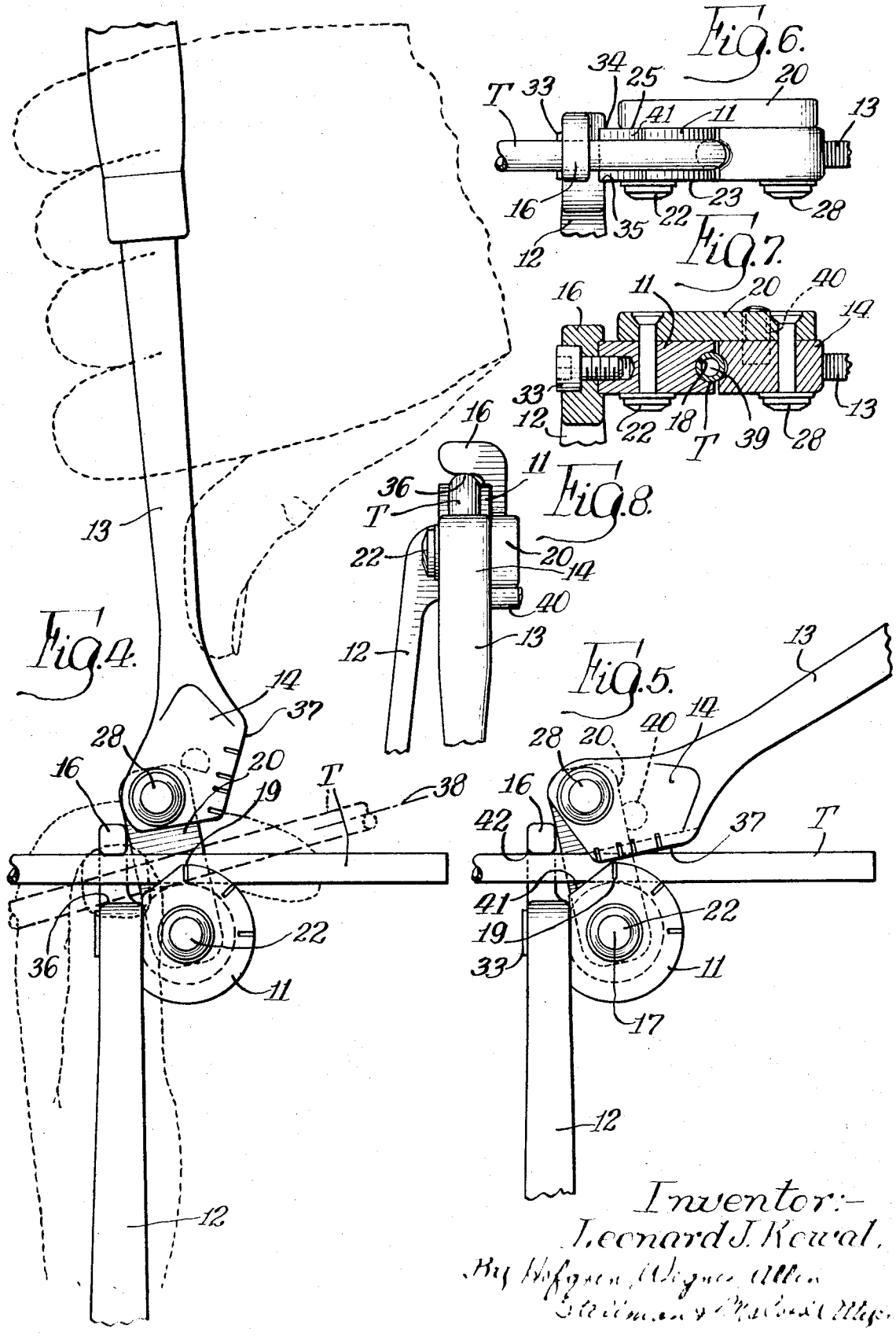

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TUBE BENDER

BACKGROUND OF THE INVENTION

1. Field of the Invention

This invention relates to tube benders and in particular to manually operable tube benders wherein a shoe is moved around a mandrel to bend a tube held in association with the mandrel by a hook.

2. Description of the Prior Art

In the conventional manually operable tube bender wherein a shoe is provided for bending a tube into a groove of a mandrel, hook means are provided for restraining the tube against movement during the bending operation. The conventional hook means comprises a hook-shaped element swingably mounted in the tool so as to be disposed in a first position away from the bend start position permitting the tube to be inserted laterally between the shoe and mandrel to the bend start position. The hook is then swung to engage the tube for restraining the tube against movement during a subsequent bending operation wherein the shoe is moved against the outer surface of the tube to press the tube progressively into the mandrel groove.

In one form of known tube bender, the hook is fixedly associated with one of the handles of the tool so as to permit swinging of the hook as an incident of swinging of the handle relative to the mandrel.

SUMMARY OF THE INVENTION

The present invention comprehends an improved tube bender having a mandrel and shoe means movable about the mandrel to bend a tube in a radially outwardly opening groove of the mandrel. A hook is fixedly secured to the mandrel adjacent the bend start point and recess means are provided to accommodate a lateral movement of the tube into the fixed hook recess.

The shoe is movably associated with the mandrel by connecting means permitting the shoe to urge the tube to the bend start position at the bend start point of the mandrel groove. In the bend start position the hook engages the tube to restrain the same from movement during a subsequent bending operation wherein the shoe is moved along the outer surface of the tube about the mandrel to press the tube progressively into the mandrel groove to effect the desired bend.

In the illustrated embodiment, one of the handles is also fixedly secured to the mandrel and more specifically is formed integral with the hook. Thus, a single securing means is provided for fixedly securing both the hook and the fixed handle to the mandrel.

The present invention further comprehends an improved arrangement of the connecting means for controlled positioning of the shoe prior to the bending operation including facilitated positioning thereof in spaced relationship to the mandrel for facilitating insertion of the tube laterally into the hook adjacent the bend start point. Means may be associated with the shoe for frictionally locking the shoe in different desired positions relative to the connecting means. Movement of the shoe to the bend start position effects an automatic swinging of the tube to the bend start disposition thereof.

The tool is arranged to permit the use thereof as a hickey for performing fast bending of tubing by means of the fixed hook and mandrel association.

The tube bender is extremely simple and economical of construction while yet providing the improved tube bending functioning discussed above.

BRIEF DESCRIPTION OF THE DRAWING

Other features and advantages of the invention will be apparent from the following description taken in connection with the accompanying drawing wherein:

FIG. 1 is a front elevation of a tube bender embodying the invention with the shoe portion being shown in dotted lines in a bend start position and in full line in the 90° bend completed position;

FIG. 2 is a fragmentary rear elevation thereof;

FIG. 3 is a fragmentary left side elevation with the shoe in the bend start position in full line and in the 90° bend completed position in dotted lines;

FIG. 4 is a fragmentary front elevation of the tube bender in open arrangement upon insertion of the tube to be bent thereinto;

FIG. 5 is a fragmentary front elevation illustrating the movement of the shoe to the bend start position;

FIG. 6 is a fragmentary section taken substantially along the line 6—6 of FIG. 1;

FIG. 7 is a section taken substantially along the line 7—7 of FIG. 1; and

FIG. 8 is a fragmentary rear elevation of the tube bender in the 90° bend completed position.

DESCRIPTION OF THE PREFERRED EMBODIMENT

In the exemplary embodiment of the invention as disclosed in the drawing, a tube bender generally designated **10** is shown to comprise a mandrel **11**, a first handle **12**, a second handle **13**, a bending shoe **14**, means **15** for movably connecting the bending shoe to the mandrel, and a hook **16**. The mandrel defines an axis **17** and is provided with a circumferential segmentally annular bending groove **18** extending coaxially to axis **17** forwardly from a bend start point **19**. A tube T to be bent is inserted into the tool adjacent bend start point **19** whereupon swinging movement of the bending shoe **14** about axis **17** adjacent groove **18** progressively bends the tube into the groove **18** to form a desired bend. In illustrating the invention the tube is shown as being bent to form a 90° bend, it being obvious to those skilled in the art that any suitable angular bend may be provided as desired up to a 180° bend.

Connecting means **15** includes a link **20**. One end **21** of link **20** is swingably mounted to mandrel **11** by a pivot **22**. The link is urged frictionally against the side wall **23** of the mandrel by a spring washer **24** disposed between the opposite side wall **25** of the mandrel and a head **26** on the pivot **22**. Shoe **14** is swingably mounted to the other end **27** of the link by a pivot **28**. The link is frictionally urged against one face **29** of shoe **14** by a spring washer **30** disposed between a head **31** of the pivot and the other surface **32** of the shoe. Thus, the connecting link is frictionally held in any one of an infinite number of positions relative to the axis of pivot **22** and to the axis of pivot **28** as desired by the user for selective retained positioning of the shoe **14** relative to the mandrel **11**.

As indicated briefly above, tube T is restrained by hook **16** against movement during the bending operation. Hook **16** is fixedly associated with mandrel **11** by

a locking screw 33 and a pair of shoulders 34 and 35 engaging the opposite side wall faces 23 and 25 of the mandrel, as best seen in FIG. 6. Hook 16 defines a tube receiving recess 36 having a height, as best seen in FIG. 1, substantially greater than the diameter of tube T. Thus, as shown in FIG. 4 in dotted lines, tube T may be inserted into hook recess 36 to extend through the space between shoe 14 and mandrel 11 radially outwardly of bend-start point 19 with the shoe swung to an outermost spaced position wherein link 20 is swung on pivot 22 to abut hook 16. Thus, hook 16 functions to limit automatically the movement of the connecting means to the spaced position of FIG. 4. At the same time, handle 13 may be manipulated to swing the shoe in a counterclockwise direction on pivot 28 thereby to space the shoe tube-engaging portion 37 outwardly from the mandrel to readily accommodate the tube T therebetween.

The axis 38 of tube T is disposed in the plane of the center 39 of bending groove 18 when the tube is moved laterally fully into hook space 36. Thus, the tube is automatically centered relative to the mandrel groove. Handle 13 is then swung on pivot 28 while maintaining link 20 against hook 16 by suitable manipulation of the handle from the position of FIG. 4 to the position of FIG. 5. The swinging movement is continued until shoe surface 37 engages tube T swinging the tube T to a bend-start position wherein the tube extends axially perpendicularly to a line between bend-start point 19 and mandrel axis 17, as shown in FIG. 5. In this position, the tube is urged upwardly, as seen in FIG. 5, against hook 16 and downwardly to bottom in the mandrel groove 18.

Shoe 14 is further provided with a stop 40 which engages the link 20 prior to the movement of the shoe surface 37 into parallel relationship with tube T whereby further swinging movement of handle 13 causes link 20 to swing on pivot 22 about axis 17 to the bend-start position shown in dotted lines in FIG. 1. In this position, link 20 extends substantially parallel to the line between bend-start point 19 and mandrel axis 17.

To facilitate the insertion of tube T into hook space 36 and between mandrel 11 and shoe 14, as seen in dotted lines in FIG. 4, the mandrel is provided with a recessed portion 41 rearwardly of bend-start point 19. Thus, the spacing of pivots 22 and 28 may be maintained relatively small, while yet permitting ready insertion and withdrawal of the tube relative to the tube bender.

Hook 16 may be provided with a slight rearward angle in recess 36, such as approximately 2° or 3°, to cause the leading edge 42 thereof to bite slightly into the surface of tube T and effectively positively preclude axial movement of the tube during the bending operation. The bending forces generated by shoe 14 against tube T are primarily inwardly toward the mandrel axis 17. However, frictional forces tend to move the tube axially during forming operations and are resisted by the hook as discussed above.

Bending of the tube is effected by further movement of handle 13 to swing the shoe on link 20 about mandrel axis 17 in a clockwise direction seen in FIG. 1. During this operation stop 40 remains in abutment with link 20 to maintain the shoe surface 37 substantially tangential to the radius of the mandrel groove about axis 17.

Upon completion of the desired bend, the user need merely swing handle 13 in a counterclockwise direction, as seen in FIG. 1, thereby disengaging stop 40 from link 20 and permitting the handle to be swung on pivots 28 and 22 back to the open position of FIG. 4. In such position the bent tube may be readily removed from the tube bender by a slight movement thereof outwardly from the mandrel groove and in a counterclockwise direction about axis 17 to clear the mandrel groove and hook with the portion of the tube extending rearwardly from bend start point 19 being arranged substantially as shown in dotted lines in FIG. 4 so as to permit ready lateral movement of the tube outwardly from the tube bender.

Thus, the invention comprehends an improved tube bender utilizing a recessed portion 41 of the mandrel in cooperation with a hook 16 fixedly associated with the mandrel and a shoe 14 movably associated with the mandrel to have selectively spaced association therewith and juxtaposed therewith. The hook 16 is positively aligned with the mandrel groove by the shoulders 34 and 35 cooperating with the mandrel side faces thereby to provide a maintained retention of the tube against movement during the bending operation. Hook 16 not only serves to retain the tube against movement but also functions as a stop for limiting the pivotal movement of the handle in the open arrangement as shown in FIG. 4, and as a stop for limiting the swinging movement of the link 20 in the open arrangement. Thus, the tube T may be readily inserted into the tube bender with an automatic sufficient clearance between the shoe 14 and mandrel being provided. Relative movement between handles 12 and 13 is controlled by the friction spring washers, thereby facilitating manipulation of the handles and insertion and removal of the tube. The shoe is mounted on the connecting means in such a manner as to cause an automatic swinging of the tube to the bend start position of FIG. 1 perpendicular to the radial line between bend start point 19 and mandrel axis 17 for further facilitated bending of the tube.

As hook 16 is rigidly fixedly associated with mandrel 11, the tube bender may be used as a hickey for effecting rough fast bends as by holding of the handles together in substantially parallel relationship to expose the hook and recessed mandrel portions for engagement with the tube to be so bent.

Tube bender 10 is extremely simple and economical of construction with a minimum of separate parts, while yet providing the improved facilitated tube bending operation discussed above.

The foregoing disclosure of specific embodiments is illustrative of the broad inventive concepts comprehended by the invention.

I claim:

1. A tube bender comprising: a mandrel having an axis and a segmentally annular, radially outwardly opening tube receiving groove concentric to said axis, said groove defining a bend-start point and a center plane perpendicular to the mandrel axis; a hook immovably fixedly associated with said mandrel and defining a recess opening generally parallel to said axis at a position rearwardly of said bend-start point for receiving the tube in a bend-start position and limiting the movement of the tube away from said mandrel rearwardly of the bend-start point and restraining the tube

against axial movement in said mandrel groove; shoe means; and means connecting said shoe means to said mandrel for swinging movement of said shoe means about said axis to bend the tube arcuately into said annular groove forwardly from said bend-start point, said connecting means being constructed to space said shoe means away from the mandrel adjacent said bend-start point in a tube loading disposition providing clearance between said shoe means and said mandrel to receive the tube freely between said mandrel, hook, and shoe means.

2. The tube bender of claim 1 wherein said hook comprises an element secured to the mandrel.

3. The tube bender of claim 1 wherein said shoe connecting means defines means for limiting the lateral movement of the tube parallel to said axis to guide the tube substantially into axial alignment with said center plane of the groove.

4. The tube bender of claim 1 wherein said hook further comprises means for limiting the rearward movement of the connecting means to a position wherein said shoe means carried thereby is spaced substantially radially outwardly from said bend-start position.

5. The tube bender of claim 1 wherein said shoe means is swingably mounted on said connecting means and said hook further comprises means for limiting the rearward swing of said shoe means relative to said connecting means when said connecting means is disposed adjacent said bend-start point.

6. The tube bender of claim 1 wherein said mandrel and hook define interlocking shoulders effectively positively positioning said hook in a preselected tube hooking position.

7. The tube bender of claim 1 including means fixedly securing the hook to the mandrel to open accurately parallel to said axis.

8. The tube bender of claim 1 wherein said hook defines a rearward biting edge fixedly positioned relative to said axis to effectively positively lock the tube against forward axial displacement during a bending thereof by said shoe means.

9. The tube bender of claim 8 wherein said biting edge comprises an acute angle corner.

10. The tube bender of claim 1 wherein said connecting means includes friction holding means for frictionally retaining the shoe means in a plurality of different positions relative to the mandrel.

11. The tube bender of claim 10 wherein said connecting means comprises a link and pivot means pivotally connecting the link to the mandrel and the link to the shoe means, and said friction holding means comprises spring washers carried by said pivot means.

12. A tube bender comprising: a mandrel having an axis and a segmentally annular, radially outwardly opening tube receiving groove concentric to said axis, said groove defining a bend-start point and a center plane perpendicular to the mandrel axis; a hook fixedly associated with said mandrel and defining a recess opening generally parallel to said axis at a position rearwardly of said bend-start point for receiving the tube in a bend-start position and limiting the movement of the tube away from said mandrel rearwardly of said bend-start point and restraining the tube against axial movement in said mandrel groove; shoe means; and means connecting said shoe means to said mandrel for swinging movement of said shoe means about said axis to bend the tube arcuately into said annular groove forwardly from said bend-start point, said connecting means being constructed to space said shoe means away from the mandrel adjacent said bend-start point in a tube loading disposition providing clearance between said shoe means and said mandrel to receive the tube freely therebetween, said mandrel being provided with a recessed portion extending rearwardly from said start point permitting a tube to be bent to be moved laterally into said recessed portion while extending in a direction parallel to said axis to a first position wherein the axis of the tube lies in said center plane of said groove and at an acute angle to a line from said axis to said bend-start point and to be subsequently moved transversely to said axis to a second position with the tube axis lying in said plane perpendicularly to said line at said start point.

13. The tube bender of claim 12 wherein said connecting means is arranged to swing the shoe means against the tube and cause the tube to move from said first position to said second position as a result of said shoe means being swung to adjacent said bend-start point.

14. The tube bender of claim 13 wherein said shoe connecting means is constructed to permit said shoe to abut the tube in said first position and to urge the tube to said second position as an incident of movement of said shoe from said tube loading position to a bend-start position wherein said shoe abuts the surface of the tube radially outwardly of said bend-start point.

15. The tube bender of claim 13 wherein said recessed portion is defined by a planar outer surface of the mandrel extending at a preselected angle to said line from said mandrel axis to said bend-start point and parallel to said mandrel axis.

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