Aug. 28, 1962 G. E. FRANCK 3,051,218

TUBE BENDER

Filed Jan. 5, 1960

Fig. 1.

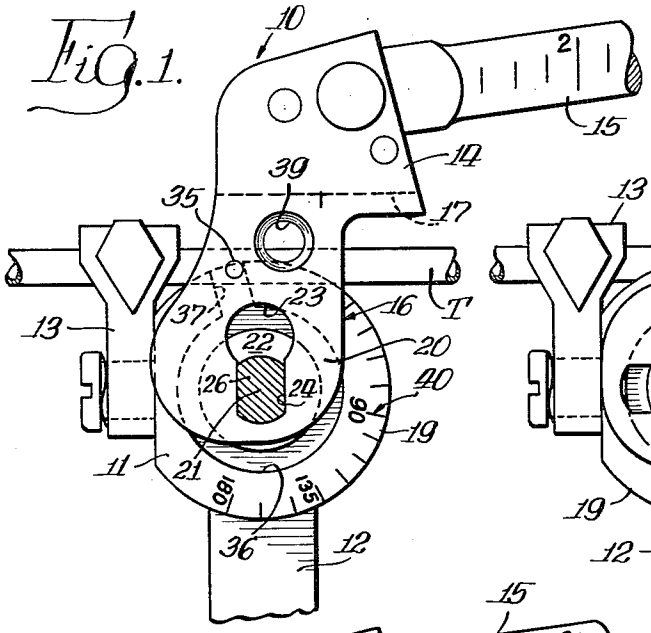


Fig. 3.

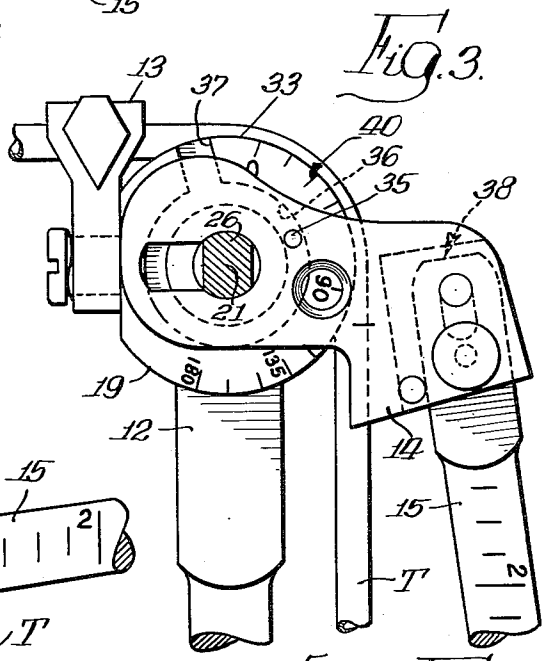


Fig. 2.

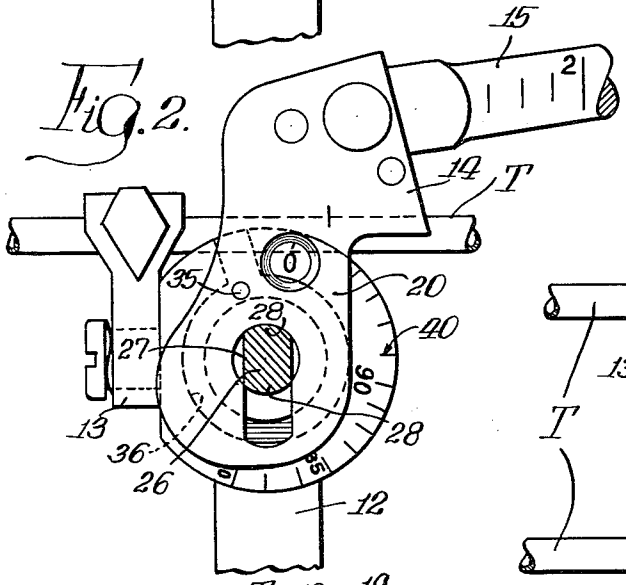


Fig. 5.

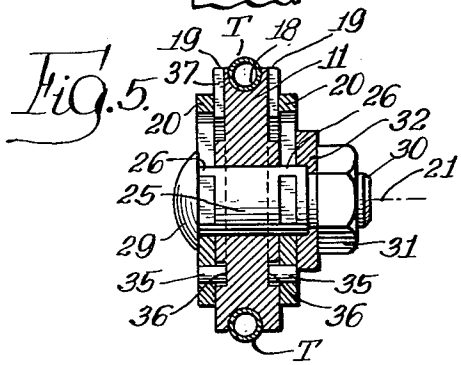
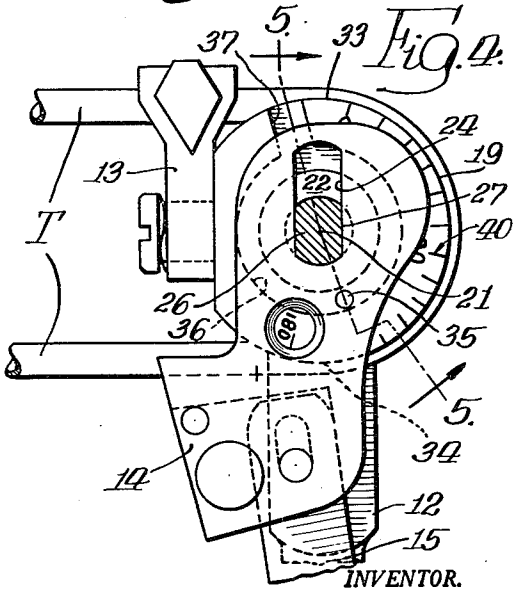


Fig. 4.



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TUBE BENDER

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5 Claims. (Cl. 153—46)

This invention relates to tube benders and in particular to manually operable tube benders.

A conventional form of manually operable tube bender is one including a mandrel having a peripheral bend-forming groove and provided with an operating handle. Means for pressing the tube into the mandrel groove are associated with the mandrel, said means conventionally comprising a shoe having a groove defining a tube pressing surface. The present invention is concerned with a new and improved means for connecting the shoe to the mandrel for movement of the shoe in a path circumjacent the groove and with the pressing surface confronting the mandrel groove to urge the tube into the mandrel groove during such movement.

It is, therefore, a principal object of the present invention to provide a new and improved tube bender.

Another object of the invention is to provide such a tube bender including connecting means permitting movement of the shoe outwardly from an annular tube pressing path at only one point in said path and maintaining the shoe in that path at all other points therein.

A further object is to provide such a tube bender wherein the connection means includes a first portion permitting movement of the shoe outwardly from the path at only two points in the path and maintaining the shoe against the tube bending forces generated at all other points therein, and a second portion precluding movement of the shoe outwardly from the path at one of said points.

Another object is to provide such a tube bander wherein the point in which the shoe is permitted to move outwardly from the path corresponds to the starting point of the bend.

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 fragmentary elevation of a tube bender embodying the invention, with the shoe spaced from the mandrel to permit insertion of a tube portion therebetween;

FIG. 2 is a view generally similar to that of FIG. 1 but with the shoe and mandrel brought together to effect initiation of a bend in the tube portion;

FIG. 3 is a view generally similar to that of FIG. 2, but with the shoe disposed as at the completion of a 90 degree bend in the tube portion;

FIG. 4 is a view generally similar to that of FIG. 3, but with the shoe disposed as at the completion of a 180 degree bend of the tube portion; and

FIG. 5 is a transverse section taken substantially along the line 5—5 of FIG. 4.

In the exemplary embodiment as disclosed in the drawing, a tube bender generally designated **10** is shown to comprise a mandrel **11** to which is secured a handle **12** and a tube holding hook **13** of conventional construction. A tube pressing shoe **14**, provided with a handle **15**, is associated with mandrel **11** by a connecting means generally designated **16** whereby a pressing surface defined by an elongate groove **17** in the shoe **14** may move in an annular path circumjacent an outwardly opening, annular groove **18** in the periphery **19** of the mandrel. As the shoe moves along the periphery **19**, it forces the tube T, which is held against longitudinal movement by hook **13**, into the groove **18** thereby forming the desired bend therein.

In order to insert the tube T between the mandrel and shoe at the beginning of the bending operation and to permit the removal of the bent tube from the mandrel groove upon completion of the bending operation, it is desirable that the shoe be selectably movable outwardly from its annular path of movement around the periphery of the mandrel. Connecting means **16** herein is arranged to provide both the annular movement of the shoe along the path circumjacent the mandrel groove and the desirable outward displacement of the shoe permitting such insertion and removal of the tube. Connecting means **16** provides such desirable functioning in an improved foolproof manner.

More specifically, connecting means **16** comprises a pair of arms **20** extending from shoe **14** to adjacent the opposite sides of mandrel **11** adjacent its axis **21**. Each arm **20** is provided with a hole **22** including a pivot portion defined by a circular arc **23** extending at least 180 degrees but less than 360 degrees, and a recess **24** defined by a rectangle extending radially outwardly from the opposed ends of the arc **23**. A post **25** is secured coaxially to mandrel **11** and includes ends **26** projecting laterally from the opposite sides of the mandrel and through opening **22** in each of the arms **20**. The transverse section of each of ends **26** includes a rectangular portion **27** having a width corresponding to the width of recess portion **24** and opposite segmentally cylindrical end portions **28** concentric of axis **21** and having a radius corresponding to the radius of arc **23**. Post **25** is further provided with a round head **29** at one end and a threaded portion **30** at the other end on which a nut **31** is threaded to act through a washer **32** in securing the post to the mandrel.

The portion of connecting means **16** defined by hole **22** and post **25** partially provides the desirable functioning discussed above. More specifically, the direction of elongation of the rectangular portion **27** of post end **26** is made to be perpendicular to the longitudinal extent of tube T when it is disposed in the mandrel groove **18** and held therein by hook **13** preparatory to forming a bend therein. Further, the direction of longation of rectangular portion **24** of hole **22** is made to be perpendicular to the longitudinal extent of the elongated groove **17** in shoe **14**. Thus as best seen in FIG. 1, when shoe **14** and mandrel **11** are disposed with post end **26** in rectangular inner portion **24** of hole **22**, the shoe is spaced substantially outwardly from periphery **19** of the mandrel In this arrangement, arcuate portion **23** is disposed between post **25** and the starting point **33** of the bend to be formed in tube T, and tube T may be readily inserted into groove **18** between shoe **14** and mandrel **11** to extend tangent to groove **18** at starting point **33**. After the tube has been thusly inserted, as shown in FIG. 2, the shoe **14** may be brought toward mandrel periphery **19** to engage surface **17** of the shoe with the wall of tube T and urge it fully into groove **18**. In this position, post end **26** is disposed in the arcuate portion of opening **22**. In this arrangement, arm **20** may pivot on post end **26** whereby shoe **14** moves along mandrel periphery **19**, as to the position of FIG. 3, pressing the tube T into groove **18** as it moves therealong to form the desired bend therein.

Once shoe **14** leaves the starting position **33** the direction of elongation of rectangular portion **24** of arm hole **22** is disaligned with the direction of elongation of the rectangular post portion **27**, thereby preventing outward displacement of the shoe relative to the periphery **19** of the mandrel. Thus, the shoe is retained in the desired annular path circumjacent groove **18** notwithstanding the development of substantial forces between the shoe and mandrel during the bending operation. This desirable circumjacent retention of the shoe is maintained over a full 180 degree

movement of the shoe about the mandrel periphery. However, when the shoe reaches the 180 degree position 34 as shown in FIG. 4, rectangular portion 24 of opening 22 becomes again aligned with the rectangular portion 27 of post end 26. Connecting means 16 further includes a second portion which precludes movement of shoe 14 outwardly from mandrel periphery 19 in this 180 degree position.

More specifically, the second portion of connecting means 16 comprises a pin 35 on each arm 20 extending parallel to axis 21 and projecting into an annular groove 36 in each of the opposite faces of mandrel 11 and extending concentrically of axis 21. A channel 37 extends radially outwardly from each groove 36 adjacent bend starting point 33. When shoe 14 is disposed at starting point 33, pin 35 is aligned with channel 37 and may move outwardly therethrough (away from axis 21) to permit the desired spacing of shoe 14 from mandrel periphery 19, as best seen in FIG. 1. When shoe 14 is moved into engagement with the tube T, as shown in FIG. 2, the pin 35 becomes disposed in annular groove 36 wherein it may move freely through the annular path defined by groove 36, as to the positions of FIG. 3 and FIG. 4. It should be noted that in the position of FIG. 4, pin 35 precludes the outward movement of shoe 14 notwithstanding the alignment of hole portion 24 with rectangular portion 27 of the post 26. Resultingly, outward spacing of shoe 14 relative to mandrel periphery 19 may be effected only at a single position wherein the shoe is at the bend starting point 33, positively precluding inadvertent spacing of the shoe from the mandrel at all other positions to assure an improved accurate bend in the tube T and prevent inadvertent damage to the tool as might occur if the post end 26 were to be disposed even partially within opening portion 24 when the user attempts to return the shoe to the starting position from the 180 degree position illustrated in FIG. 4.

To facilitate bending of tube T, handle 15 may be connected to shoe 14 by means of a two-position connection structure generally designated 38 permitting handle 15 to be moved to a position at right angles to the position as shown in FIG. 3, whereby the shoe 14 may be moved from the position of FIG. 3 to the position of FIG. 4 without a crossing of handle 12 by handle 15 during this operation. A more detailed description of structure 38 is set forth in my copending application, Serial No. 804,256, now Patent No. 2,979,976. Arm 20 may further be provided with an opening 39 cooperating with an angle scale 40 on mandrel 11 to indicate the degree of bend effected by the tool 10.

In using tool 10, a workman firstly arranges the tool as illustrated in FIG. 1 with shoe 14 spaced outwardly from the mandrel periphery 19 at bend starting point 33. This outward spacing is permitted by the movement of pin 35 through the channel 37 and the movement of hole 22 outwardly to receive the post end 26 in hole portion 24. Tube T is then inserted between the groove surface 17 and mandrel groove 18 and hook 13 is engaged with the tube to hold the tube in association with the mandrel. The shoe 14 is next brought into engagement with the outer surface of tube T by movement of arm 20 downwardly as seen in FIG. 2 to dispose pin 35 in annular groove 36 and to receive post end 26 in arcuate portion 23 of opening 22.

The bending of tube T is then effected in a substantially conventional manner by urging handle 15 in a clockwise direction as seen in FIGS. 2, 3 and 4 toward handle 12 until shoe 14 has moved along groove 18 the preselected angular amount. The shoe 14 is maintained in the annular path circumjacent groove 18 in all angular positions away from starting point 33 during such bending of the tube T.

Upon completion of the desired bend, handle 15 is reversely swung to move shoe 14 back to the starting point 33. The shoe 14 is now moved outwardly from engagement with the bent tube T to the position of FIG. 1. Hook 13 is then disengaged from tube T permitting the tube to be disengaged from the tool.

While I have shown and described one embodiment of my invention, it is to be understood that it is capable of many modifications. Changes, therefore, in the construction and arrangement may be made without departing from the spirit and scope of the invention as defined in the appended claims.

I claim:

1. A tube bender comprising: a mandrel having a peripheral bend-forming groove having a bend-start point; a shoe having a tube-pressing surface; and means connecting the shoe to the mandrel for movement of the shoe in a path circumjacent said groove away from said bend-start point and with said surface confronting the groove to urge a tube into the groove during such movement, said connecting means including an arm extending from the shoe, a pin on one of said mandrel and arm extending transversely to the central plane of said groove, and a pin receiving groove in the other of said mandrel and arm having an annular portion and a straight portion extending outwardly from the annular portion substantially in alignment with said bend-start point, a post on one of said mandrel and arm and a hole in the other of said mandrel and arm, the one of the post and hole on said mandrel being at the axis of said bend-forming groove, said hole having a pivot portion and a recess portion extending radially outwardly from the pivot portion, the post and recess portion being complementary to permit movement of the shoe outwardly from said path only at the bend-start point and 180° therefrom and maintaining the shoe in said path at all other points along said path.

2. The tube bender of claim 1 wherein the cross-section of said pivot portion in a plane perpendicular to the mandrel groove axis is defined by a circular arc extending more than 180° and less than 360°, the cross-section of said recess portion in said plane is defined by a rectangle extending outwardly from between the ends of the arc, and the cross-section of the post in said plane is defined by a rectangular mid-portion having a width corresponding to the width of said recess portion of the hole to permit movement of said post into and from said recess portion when desired, said cross-section of the post in said plane further being defined by segmentally circular end portions concentric with said mid-portion and having a radius corresponding to the radius of said arc to permit pivoting of said post in said pivot portion of the hole when desired.

3. A tube bender comprising: a mandrel having a peripheral, annular bend-forming groove; a shoe having a tube-pressing surface; and means connecting the shoe to the mandrel for movement of the shoe in a path circumjacent said groove and with said surface confronting the groove to urge a tube into the groove during such movement, said connecting means including an arm on the shoe provided with a hole having a pivot portion having a circular cross-section and a recess portion extending radially from the pivot portion, a cylindrical post axially of the mandrel and extending through said hole, said post being arranged to be received in said recess portion in only two positions, a pin on one of said mandrel and shoe arm extending transversely to the central plane of said groove, and a guide groove in the other of said mandrel and shoe arm having an annular portion and an outwardly extending portion at one point in the annular portion, said pin being laterally slidably fitted in the guide groove permitting movement of the shoe outwardly from said path at only one point in said path corresponding to one of said post positions, the cross sectional area of the pin being smaller than the cross sectional area of the post.

4. The tube bender of claim 3 wherein said one point in the path of movement of the shoe comprises a point

in the bend-forming groove at which the bend is initiated.

5. A tube bender comprising: a mandrel having a peripheral annular bend-forming groove extending at least approximately 180°; a shoe having a tube-pressing surface; and means connecting the shoe to the mandrel for movement of the shoe in a path circumjacent said groove and with said surface confronting the groove to urge a tube into the groove during such movement, said connecting means including a first portion arranged to permit movement of the shoe outwardly from said path at only two, 180° spaced points in said path and maintain said shoe in said path against the tube-bending forces generated at all other points therein, and a control portion arranged to permit movement of the shoe outwardly from said path at only one of said points, said control portion being substantially less capable than said first portion of resisting forces such as the tube-bending forces, said one point comprising the starting point of the bend.

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