May 26, 1959 L. J. KOWAL 2,887,917

TUBE BENDER SCALE MEANS

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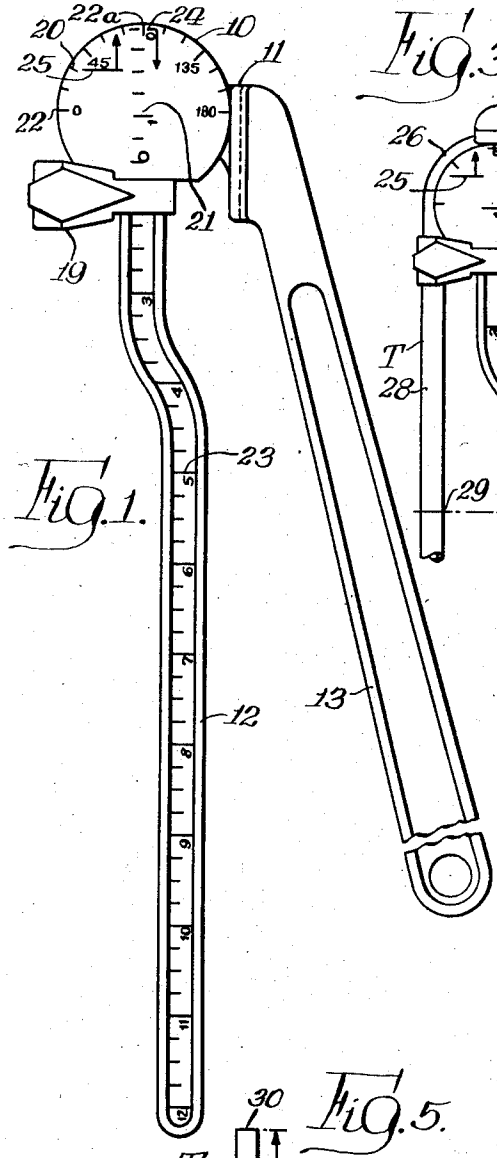

Fig. 1.

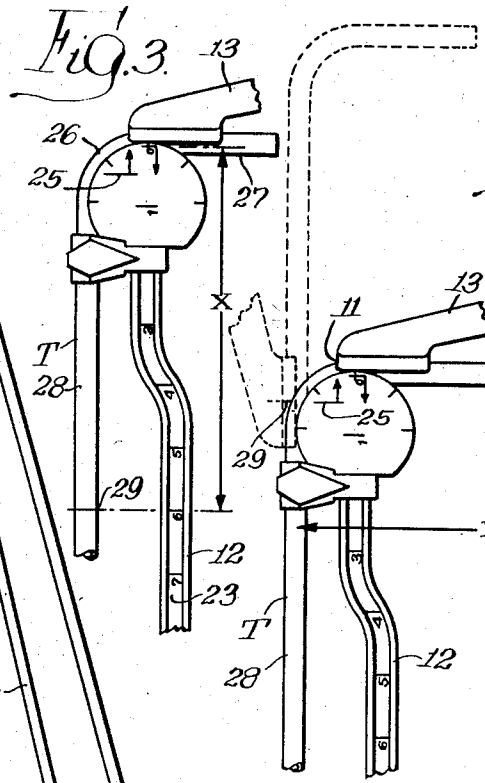

Fig. 3.

Fig. 4.

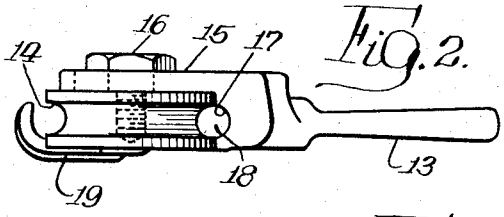

Fig. 2.

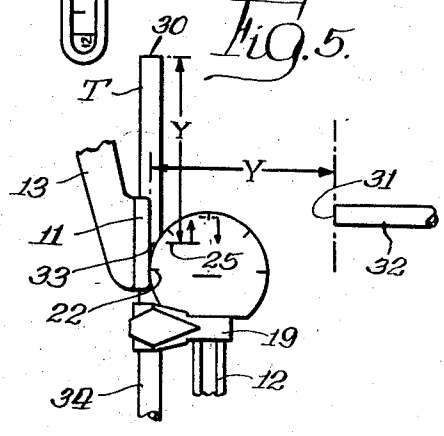

Fig. 5.

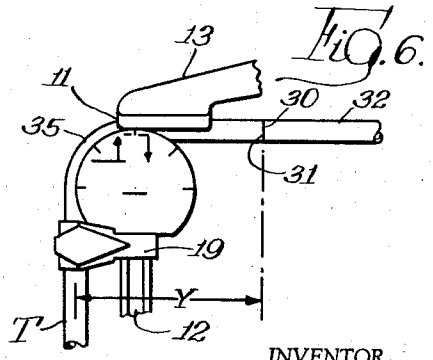

Fig. 6.

INVENTOR.
Leonard J. Kowal,
BY Schroeder, Hofgren, Brady & Hofgren Attys.

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TUBE BENDER SCALE MEANS

Leonard J. Kowal, Prospect Heights, Ill., assignor to Imperial Brass Manufacturing Company, a corporation of Illinois

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8 Claims. (Cl. 81—15)

This invention relates to a tube bender and in particular to a tube bender having new and improved associated means for determining the proper disposition of a tube therein to effect a desired arrangement of the resultant bent tube.

In making a bend in tubing with a manual tube bender, the operator conventionally determines the approximate location of the desired bend and then associates the tube with the bend forming means of the bender to effect the bend at this location. Should the resultant bend be located somewhat from the desired location, the yieldable nature of the tubing is utilized to compensate for this positional discrepancy. In certain instances, however, as where the end of the bent tube must butt accurately with the end of a fixed tube or element to which it is to be connected, no such positional discrepancy may be tolerated. A serious disadvantage of the presently known tube benders is that no means are provided therewith for accurately determining the positioning of the tube relative to the bending means so that the resultant bent tube may be accurately suitably arranged.

The principal object of this invention is to provide a new and improved tube bender having associated means for determining the proper positioning in the bender of the tube to be bent to result accurately in a desired arrangement.

Another object is to provide such a tube bender wherein scale means are carried by the mandrel and handle to indicate a spacing from the mandrel groove for measuring the extension of the tube from the groove.

A further object is to provide such a tube bender wherein the scale means are arranged to indicate the spacing from the center of the mandrel groove opposite the handle.

Still another object is to provide such a tube bender having scale means correlated with the radius of the mandrel groove indicating the proper positioning of the tube to be bent to compensate for the effect by the curvature of the bend on the dimensioning of the bent tube, thereby to permit accurate spacing of portions of the tube separated by the bend.

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

Fig. 1 is an elevational view of a tube bender embodying the invention;

Fig. 2 is an end view thereof;

Fig. 3 is a reduced, fragmentary view thereof and showing a tube therein having a first 90° angle bend;

Fig. 4 is a reduced, fragmentary view thereof similar to Fig. 3, showing the tube of Fig. 3 as formed with a second 90° bend to space parallel straight portions of the tube at a predetermined distance, the positioning of the tube prior to the provision of the second bend being shown in dotted lines;

Fig. 5 is a reduced, fragmentary view thereof showing a first, straight tube associated therewith prior to a bending operation, and the end portion of a second tube positioned a predetermined distance laterally from the axis of the first tube; and

Fig. 6 is a view similar to that of Fig. 5 but with the first tube bent 90° to butt with the end of the second tube.

In the exemplary embodiment of the invention as disclosed in the drawings, a tube bender is shown to comprise a mandrel **10** and a cooperating shoe member **11**. Shoe member **11** is moved relative to the mandrel during the tube bending operation by means of a first handle **12** associated with the mandrel and a second handle **13** associated with the shoe member. Shoe member **11** is mounted for movement along a tube bending groove **14** peripherally in mandrel **10**, by means of an arm **15** pivotally attached to the side of the mandrel by means of a suitable bolt **16**. Shoe member **11** is provided with a groove **17** complementary to mandrel groove **14** to define with groove **14** a tube receiving space designated **18**, as seen in Fig. 2. Mounted on handle **12** adjacent mandrel **10** to swing about the axis of the handle is a suitable hook **19** arranged to encircle a portion of a tube T to be bent when the tube is placed in the mandrel groove preparatory to a tube bending operation and prevent undesirable movement of the tube relative to the mandrel during the bending operation.

The above described structure is more or less conventional in such manually operated tube benders. The instant invention comprehends the provision of suitable scale means associated with such a tube bender for accurately indicating the positioning of the tube to be bent so that the tube will have a predetermined dimensioned arrangement subsequent to the provision of one or more bends therein. For this purpose, three cooperating scale means are provided. A first scale means **20** comprises an angular scale on mandrel **10**, indicating angle measurements taken about axis **21** of the mandrel, which axis corresponds to the center of generation of mandrel groove **14**. Scale **20** measures this angle from a starting or zero point **22** illustratively marked "0," as seen in Fig. 1, which point is at the portion of mandrel groove **14** to which tube T is tangent prior to the formation of a bend therein.

A second scale means **23** comprises a scale extending from a point **24** on mandrel **10** aligned with the cross-sectional center of tube receiving space **18**, point **24** being circumferentially spaced 90° from zero point **22**. Scale **23** extends longitudinally from point **24**, across the mandrel, and along handle **12** and serves to indicate a spacing from point **24**.

A third scale means **25** comprises a mark on mandrel **10** at a predetermined distance from starting point **22**, indicating the proper positioning of a measured point on the tube to permit the bending of the tube at a 90° angle with a resultant accurate spacing as desired of laterally related portions of the tube. More specifically, mark **25** is spaced from starting point **22** a distance compensating for the curvature of the tube bend so that when one end of a portion of tube T, the portion having a length accurately equal to a desired spacing between the axis of tube T at starting point **22** and another portion of tube T (such as a portion **27** as seen in Fig. 4) or another element laterally of tube T (such as an element **32** as seen in Fig. 6), is aligned with mark **25** and the tube is then bent 90°, the spacing between the plane of the axis of tube T perpendicular to the radius of the mandrel groove at point **22** and said laterally spaced portion or element is accurately equal to that predetermined length. I have found that when mark **25** is spaced from zero point **22** in a direction parallel to the axis of tube T at point **22** (i.e. in the direction of a tangent to groove **14** at point **22**) a distance equal to the circumferential length of the axis of groove **14** between

zero point 22 and point 24 less the distance between the cross sectional center of tube T in the mandrel groove at zero point 22 and mandrel axis 21, the curvature of the bend is accurately compensated. This increment has been found to be directly proportional to the distance between the cross-sectional center of space 18 and axis 21 and to be substantially .57 of this distance.

The use of the scale means 20, 23 and 25 permits ready and accurate dimensioning of laterally related portions of tube T and permits accurate butting of the tube end with an associated tubular element. To obtain a bent tube having accurately spaced parallel portions such as 27 and 28 in Fig. 4, the tube bender may be utilized as seen in Figs. 3 and 4. Thus, a first, right-angled bend 26 is provided in tube T as seen in Fig. 3 by moving shoe member 11 through an arc of 90° from zero point 22 as determined by first scale means 20. With the tube still in the position of Fig. 3, the desired spacing, designated X, between the axes of right-angularly extending portion 27 and portion 28 at zero point 22 (see Fig. 4) is then measured off from point 24 to the corresponding point on second scale 23, as seen in Fig. 3. In the illustrated embodiment, the desired spacing X is 6" and, thus, a point 29 is determined on tube T which is aligned with scale marking 6" of scale 23.

Tube T is then moved longitudinally relative to starting point 22 of the mandrel groove to the position shown in dotted lines in Fig. 4 wherein point 29 is aligned with third scale means 25. Tube T is now bent by manipulation of shoe 11 to the desired 90° angle, as determined by scale means 20. The resultant spacing between the axes of portions 27 and 28 of tube T will be accurately the dimension X, in the illustrated example specifically 6".

In Figs. 5 and 6 the utilization of the tube bender to provide a bend in tube T resulting in the abutment of an end 30 with an end 31 of a second element or tube 32 is shown. In this use of the tube bender, a point 33 is determined which is spaced from tube end 30 a distance equal to the distance designated Y between the end 31 of element 32 and the extension of the axis of the portion 34 of tube T at zero point 22. Point 33 is aligned with mark 25 and the desired 90° bend is formed in the tube by manipulation of shoe 11. As seen in Fig. 6, tube end 30 accurately butts with element end 31 when the formation of bend 35 is completed.

In each case, the additional length of tube T required to compensate for the curvature of the bend is accurately and automatically compounded with the measured length of the tube conforming to the desired spacing to result in a configuration of the bent tube wherein the desired spacing is obtained notwithstanding the inclusion of the bend in the length of tube defining this spacing.

To illustrate the invention two examples of the use of the illustrated embodiment thereof are herein disclosed. It is obvious that other methods of employment may be used depending on the specific spacing and configuration requirements involved.

While I have shown and described certain embodiments 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 provided with a peripheral, annular tube bending groove having a bend starting-point; a shoe member associated with the mandrel to move around the mandrel groove and having a complementary groove defining with the mandrel groove a tube receiving space; a handle secured at one end to the mandrel to extend parallel to a first radius of the groove at right angles to a second radius of the groove through said starting-point; and scale means on the handle to indicate a spacing from the cross-sectional center of the tube receiving space at said first radius, whereby the spacing of the axis of a portion of the tube in said mandrel groove and bent at right angles to a portion of the tube tangent to the groove at the starting-point from a point on the tube laterally of the handle may be determined.

2. A tube bender comprising: a mandrel provided with a peripheral, annular tube bending groove generated about an axis and having a bend starting-point; a shoe member associated with the mandrel to move around the mandrel groove and having a complementary groove defining with the mandrel groove an annular tube receiving space; a handle secured at one end to the mandrel to extend parallel to a first radius of the groove at right angles to a second radius of the groove through said starting-point; scale means on the handle to indicate a spacing from the tube receiving space at said first radius; and a scale mark on the mandrel spaced from the second radius in the direction of and parallel to the first radius a distance substantially .57 the radius of generation of the groove.

3. A tube bender comprising: a mandrel provided with a peripheral, annular tube bending groove generated about an axis and having a bend starting-point; a shoe member associated with the mandrel to move around the mandrel groove and having a complementary groove defining with the mandrel groove a tube receiving space; a scale mark on the mandrel spaced from a radius of the groove through the starting-point in the direction of the tangent to the groove at said starting-point and toward the tube receiving space a distance equal to the difference between the circumferential length of the central axis of the tube receiving space between the starting-point and a point of the groove 90° from the starting-point and the spacing between said tangent and the axis of groove generation.

4. The tube bender of claim 3 wherein the scale mark is spaced from said radius a distance substantially .57 the distance between said axis of groove generation and the center of said tube receiving space.

5. A tube bender comprising: a mandrel provided with a peripheral, annular tube bending groove having a bend starting-point; a shoe member associated with the mandrel to move around the mandrel groove and having a complementary groove defining with the mandrel groove a tube receiving space; a handle secured at one end to the mandrel to extend parallel to a first radius of the groove at right angles to a second radius of the groove through said starting-point; first scale means on the handle to indicate a length of tube to be bent extending from a first point on the tube; and second scale means to indicate an incremental length of the tube to be bent to be added to the length determined by the first scale means to cause the distance between said point and a plane perpendicular to said second radius and through the center of the tube receiving space at said starting-point to be equal to the length determined by the first scale means when a second point on the tube spaced from said first point a distance equal to the sum of said lengths is disposed at said starting-point and the tube is bent 90° to align said first point with the tube receiving space at said first radius.

6. A tube bender comprising: a mandrel provided with a peripheral, annular tube bending groove having a bend starting-point; a shoe member associated with the mandrel to move around the mandrel groove and having a complementary groove defining with the mandrel groove a tube receiving space; a handle secured at one end to the mandrel to extend parallel to a first radius of the groove at right angles to a second radius of the groove through said starting-point; and scale means associated with the handle and mandrel to indicate a length of the tube to be bent which will have a desired extension perpendicular to the first radius away from an end of the length at said starting-point.

7. In a tube bender having a mandrel provided with a groove in which a tube is bent by means of a suitable cooperating shoe, means for indicating the proper association of the mandrel and the tube to be bent relative to the groove to have a resultant desired spacing between laterally related portions of the bent tube, comprising: a first scale means for determining a length of the tube to be bent having a longitudinal extent equal to the desired spacing, and a marking on the mandrel indicating the necessary disposition relative to the mandrel groove of one end of the determined length to compensate for the decrease in the effective spacing between the ends of the determined length resulting from the bending of a portion thereof.

8. In a tube bender having a mandrel provided with a groove in which a tube is bent by means of a suitable cooperating shoe, means for indicating the proper association of the mandrel and the tube to be bent relative to the groove to have a resultant desired spacing between laterally related portions of the bent tube, comprising: a

first marking on the mandrel indicating the starting-point of the bend; and a second marking correlated with the first marking indicating the necessary disposition relative to the mandrel groove of one end of a length of the tube to be bent to compensate for the decrease in the effective spacing between the ends of the length resulting from the bending of a portion thereof.

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