Feb. 24, 1948. T. V. PEARSON ET AL 2,436,776

REVERSIBLE TUBE BENDER WITH SIDE ANGLE INDICATOR

Filed March 17, 1944 3 Sheets-Sheet 1

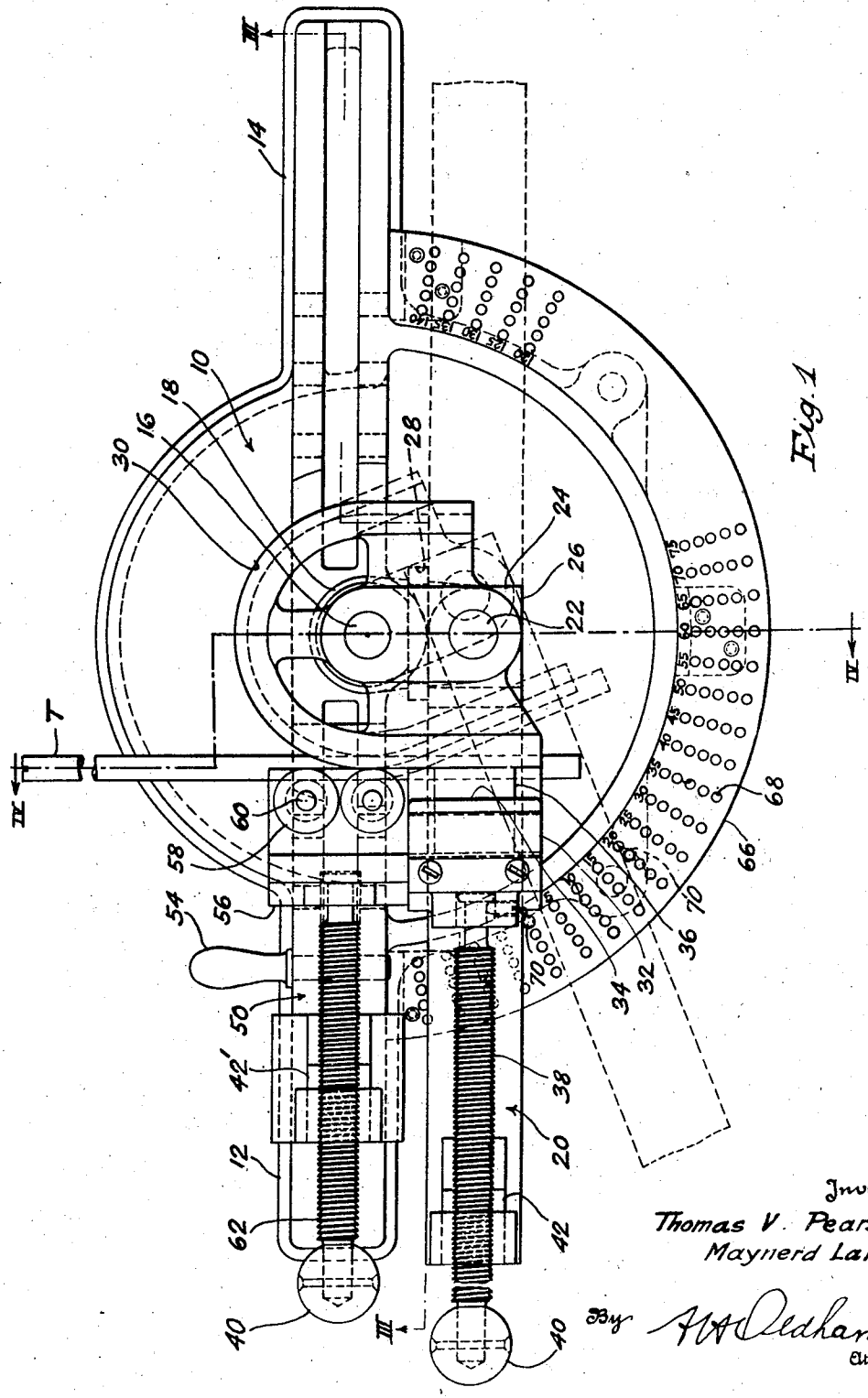


Fig. 1

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Fig. 2

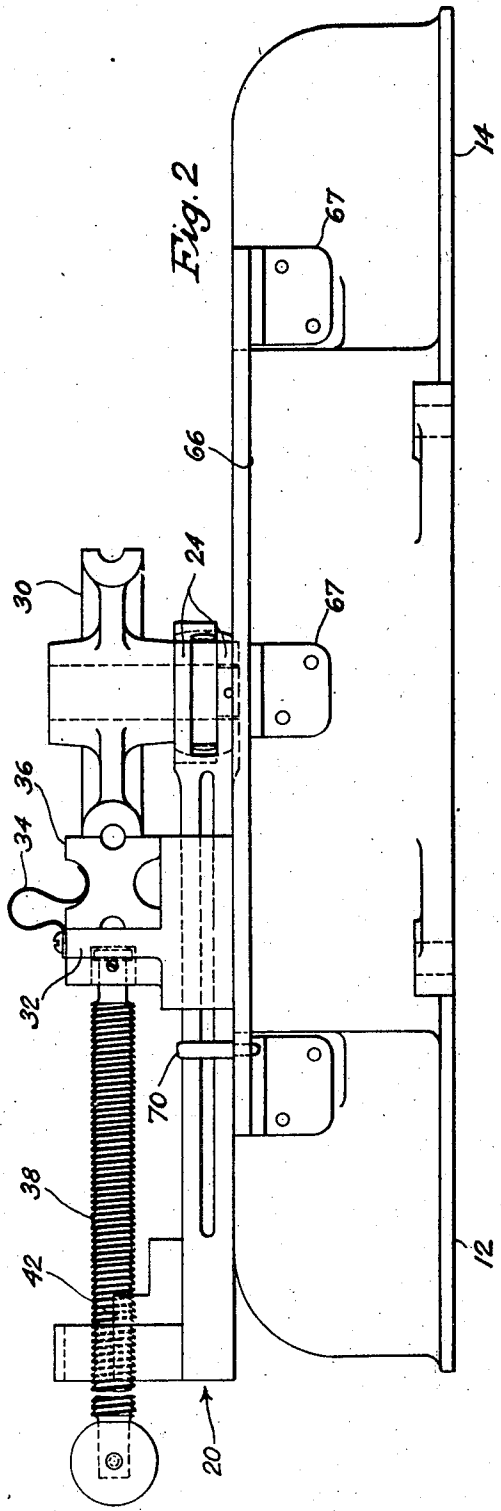
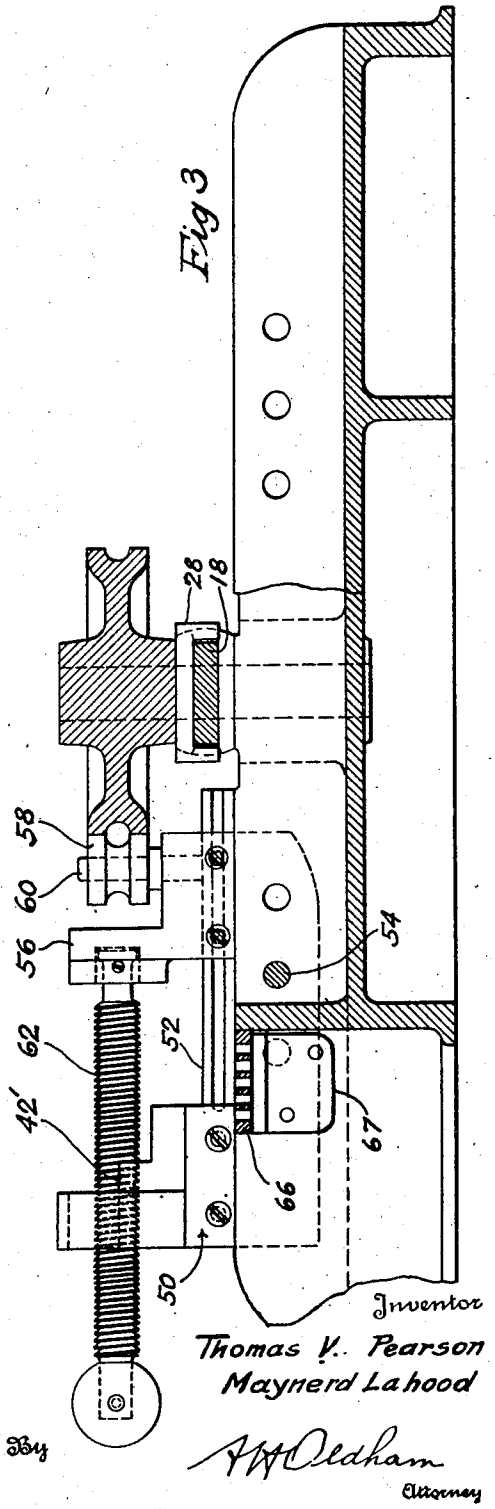


Fig 3



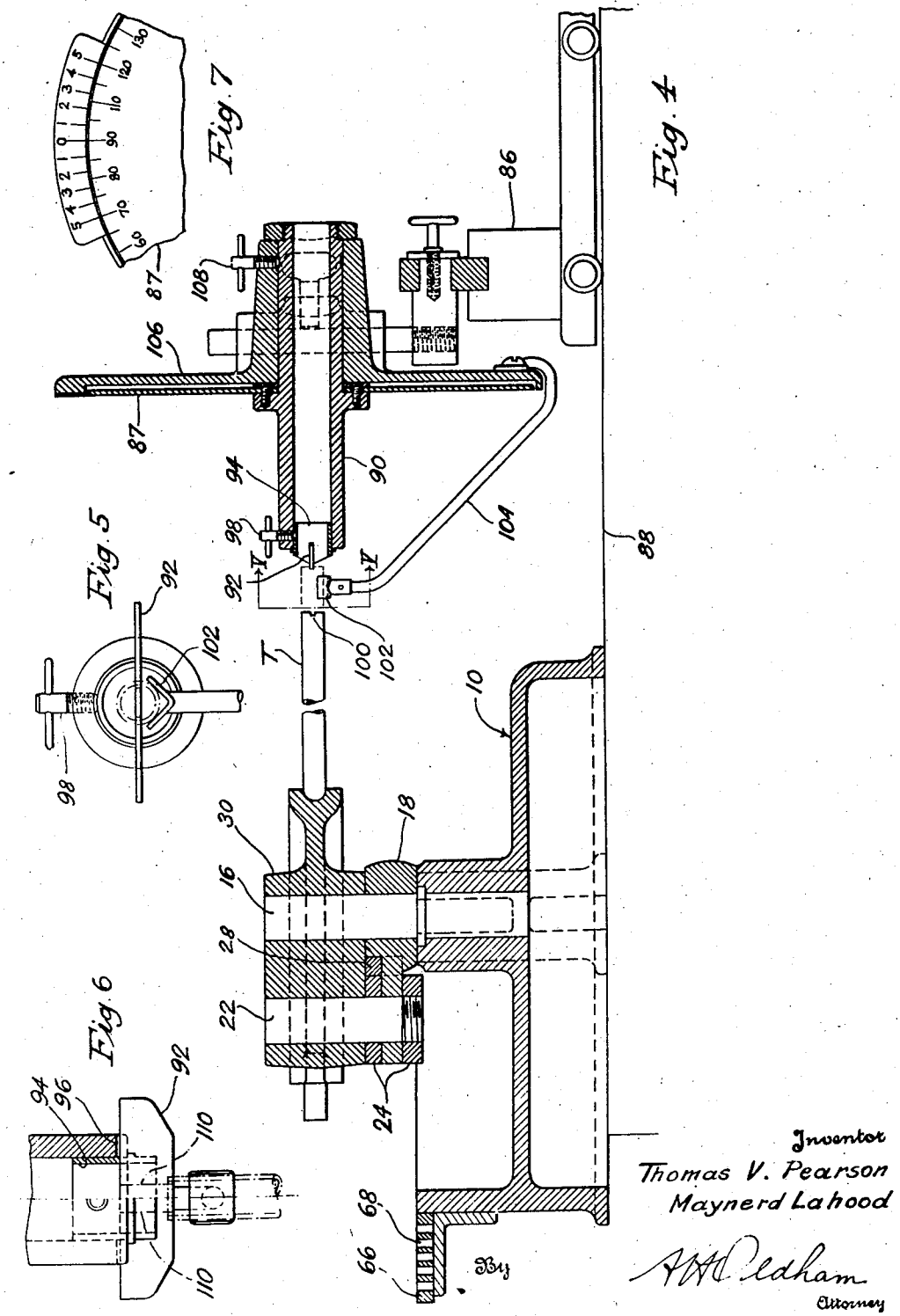
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REVERSIBLE TUBE BENDER WITH SIDE ANGLE INDICATOR

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This invention relates to the improvement of apparatus for bending tubes, and, in particular, to tube benders operated by hand. Some features of this improvement, however, are also applicable to power-driven tube benders.

Tube-bending apparatus of previous construction was not adapted to be operated at high efficiency in output, nor was it very easy to produce exact duplicates of tubes formed.

It is the general object of this invention to avoid and overcome the foregoing and other difficulties of and objections to prior art practices by the provision of suitable devices for speeding up and improving production of bent tubes.

Another object of this invention is to provide apparatus for the exact duplication of bending angles of a tube in the shortest possible time.

Another object of this invention is the provision of apparatus embodying quick change and fixation of the operating arm and the bending block arm from the position of making right-handed bends to that of making left-handed bends.

Another object of this invention is the avoidance of a slidable tube guide moving together with the tube to be bent.

A further object of this invention is the inclusion of means for the instant determination of the side angle between bends of a tube, that is, the angle between the planes of adjacent bends.

The aforesaid objects of the invention, and other objects which will become apparent as the description proceeds, are achieved by providing, first, an index segment adapted for inserting a stop for determining the desired bending angle and to insure exact duplication of parts; second, a set of guiding rolls on the stationary vise support instead of a sliding part moving with the tube to be bent; third, a quickly releasable lock between the operating or bending arm and the bending block lever for changing the operating lever to the other side for the purpose of making reversed bends; and, fourth, a diametrical loose notch and knife connection between one end of the tubing and the shaft end of the side angle indicator, respectively, for rapidly and correctly indexing the side angle bends of the tube.

For a better understanding of this invention, reference should be had to the accompanying drawings, wherein:

Fig. 1 is a plan view of the tube bender; Fig. 2 is a front elevational view of Fig. 1; Fig. 3 is a cross-sectional view taken on line III—III of Fig. 1; Fig. 4 is a sectional view taken in the center

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of the tube bender on line IV—IV and showing, in addition, a side angle indicator used in connection with the tube bender; Fig. 5 is a front view in the direction V—V of Fig. 4; Fig. 6 is a top view, partly in section, of Fig. 5; and Fig. 7 is a fragmentary front view of the side angle indicator.

Although the principles of this invention are not restricted to the specific construction shown in the drawings, it will be described as illustrated.

With specific reference to the form illustrated in the drawing, the numeral 10 indicates the base as a whole of a hand-operated bending machine of known construction, which includes U-shaped supports 12 and 14 extending from the center outwardly in opposite directions. About a center pin 16, fixed in the base 10, is swingable a lever 18, to the end of which is pivotally attached the forked end of the bending lever 20, indicated as a whole, by a pin 22 screwed into the bottom side of the fork 24, which is provided on the top side with straight flanks 26, instead of having the usual rounded end like the bottom side. The hub of the lever 18 flush with the top of the fork 24 is cut off sufficiently at one side to provide space for an easily removable key 28 of U-shape, which locks the operating or bending lever 20 in its position relative to the lever 18. However, when the key 28 is removed the empty space left permits the lever 20, in spite of its straight flanks 26 of the upper fork end, to be swung about the pin 22 into a position opposite therefrom in which it is again locked together with the lever 18 to be then operated from this side for making bends in reversed direction.

On the pins 16 and 22 extending over the hub of the lever 18 and fork 24, respectively, is removably mounted the bending block 30, which, because of the key 28, can be operated by the bending lever 20. The bending lever 20 includes a slidable support 32 which holds, by spring means 34, in loose connection, a tube vise jaw 36. This jaw is pressed against the straight portion of the bending block, for tightly gripping the tube, by means of a spindle 38 provided with a handle 40. The spindle 38 turns in a half nut 42 fastened to the near end of the bending lever, thus permitting the spindle to be lifted out from the half nut for rapid operation of the clamp.

Cooperating with the bending block 30 is a second vise 50, indicated as a whole, which consists of a guide piece 52 adjustably mounted and held in place by a removable pin 54 either on the support 12 or 14, depending on whether a right or left-handed bend is to be made, and of a slidable

support 56 which carries two tube guide rolls 58 revolvable on pins 60 inserted in the support 56 and cooperating with the bending block 30. These rolls can be engaged with and disengaged from the bending block by a spindle 62 turning in a half nut 42' and permitting it to be lifted out from the half nut. The guiding rolls 58 have the advantage over previous constructions that during the bending process they are stationary, unlike the guide piece which used to move together with the advancing tube and which had to be put back to its original position at each bending operation.

To simplify quick determination of the correct bending angle of the tube without loss of time, the segment 66, fastened to the base 10 by brackets 67 is provided with holes 68 marking the bending angles of the tube. Five holes, substantially radially aligned, are positioned at each increment of 5 degrees on the segment 66. A pin 70, adapted to engage with the side of a lever 20, is inserted as a bending lever stop in the hole 68 indicating the angle the tube is to be bent. This pin 70, best illustrated in Figure 2, is shown in Figure 1 in zero position from where it is moved to a hole 68 whichever corresponds to the desired bending angle as indicated, for instance, by the position of the bending lever at 21 degrees in dotted lines. The movement of the bending lever from one hole to the next one corresponds to one degree bending angle. This arrangement will admit of fast handling with no loss of time for watching the bend angle indicator at each separate bending process.

For quickly making accurate side angle tube bends, the side angle indicator 86 of conventional construction, including the dial 87, used in combination with the tube bender, both of which are mounted on a table 88, is provided at the front end of its rotatable hollow indicator shaft 90 with a knife-like edge 92. This knife edge fits into slots of a shouldered bushing 94, to which it is fastened and which is inserted into the bore of the shaft 90. The knife edge 92 also is held by slots 96 in the front end of the shaft against turning of the bushing 94 in the bore, and a set screw 98 secures the bushing in its location. To readily match the notch 100, sawed into the end of the tube T, with the knife edge 92, an angularly-shaped guide 102 is attached to a support 104, which is fastened to the vertically-adjustable dial frame 106. A set screw 108 holds the dial at the angle at which the tube is to be bent relative to the position of slot in the tube. In most cases the tubes of smaller size can be bent without a mandrel. However, in cases where a mandrel is required, the knife blade 92 will be cut out at the lines 110 to permit a passage for the mandrel.

From the foregoing description it should be clear that the operation of the improved tube bender by the various features described is very much simplified, as compared to previous constructions. For reversing the bending operation, after removing the bending block 30, the key 28, which, of course, can be replaced by other similar means, can be readily removed for swinging the bending lever in opposite directions, which in this latter position is secured again with subsequent insertion of the bending block upside down in opposite position. In addition the vise 50, including the elements 52, 56 and other associated parts secured by the pin 54 to the support 12 is removed and mounted on the support 14 opposite thereof. This change, of course, requires that also the dial assembly 86 is moved laterally to a position symmetrical to that of the blank, as shown in Figure 1. This arrangement avoids the need of using a bevel gear drive, which is rather expensive and unnecessary for smaller size tubes, such as occur to a great extent, especially in the aircraft industry and in similarly related art.

The index segment 66 used instead of the conventional dial for reading the bending angle, has the great advantage that by inserting the pin 70 in one of the holes determining the desired bending angle, differences in the shape of tubes to be duplicated are entirely excluded, and the time for reading the dial for each bend is saved.

A further saving of time is achieved by the arrangement of stationary, rotatable tube guide rolls 58 keeping the tube in proper alignment during bending and saving the much more expensive slidable tube guide which also at times interferes with unobstructed production.

For tubes having multiple bends, the notch and knife edge indexing method is much more economical in bending a batch of tubes by first making one and the same bend on all tubes, so that only one setting of the tube bender is required for that particular bend and again only one setting for every other different bend, instead of completing all bends on each separate tube. The latter process was necessary when clamping the tube in the side angle indicator in order to obtain the correct side angles between the bends, because, after once having removed the tube from the side angle indicator after the first bend, it was cumbersome to make adjustments for finding the side angle for the next bend. In addition, under such circumstances, adjustments on the tube bender had to be made after each separate bend. All of these difficulties are removed by providing each tube at one end with a diametrical saw cut 100 of low depth which, held against the knife edge 92, being, for instance, in horizontal position and clamped against the bending block, makes the first bend of the tube run in the direction of the slot 100. This same process is repeated for each tube. Now the side angle is set on the side angle indicator, the tube again indexed by the knife edge, and bent in the usual way, thus exactly duplicating the side angle for each tube. By this method of indexing and bending, the time for bending a batch of tubes can be considerably shortened as compared with that of the old method, and, at the same time, a more uniform product will be obtained. It should be mentioned here that this last feature is not restricted to hand-operated tube benders, but may be equally well applied to power-driven tube benders.

From the foregoing description, it will be obvious that the improvements presented in this case are a considerable step forward in the tube-bending art, since the cost and time of production is cut to a minimum.

While, in accordance with the patent statutes only one embodiment of the invention has been illustrated and described in detail, it is to be particularly understood that the invention is not limited thereto or thereby, but that the inventive scope is defined in the claims.

We claim:

1. The combination with a tube bender, including a base, of a center pivot in said base, a bending block revolvable about said pivot, means for clamping and shaping a tube to be bent against said bending block, a side angle indica-

tor spaced from said tube bender being provided with a centrally positioned knife edge for loosely engaging a diametrically slotted end of said tube for the purpose of indexing the side angle between bends of the tube.

2. The combination with a tube bender of a side angle indicator having a rotatable dial, a shaft fixed to and supporting this dial, and a knife edge diametrical to and attached to the front of said shaft for loosely engaging a diametrically slotted end of a tube to be bent for the purpose of indexing the side angle between bends of the tube.

3. The combination with a tube bender of a side angle indicator having a rotatable dial, a shaft fixed to and supporting this dial, and a knife edge securely attached in diametrical position to the front face of said shaft for loosely engaging a diametrically slotted end of a tube to be bent for the purpose of indexing the side angle between bends of the tube.

4. The combination with a tube bender, of a side angle indicator having a rotatable dial a shaft fixed to and supporting said dial a tubular holder inserted in the front end of said shaft and secured thereto against relative movement, and a knife edge index diametrically attached to said holder, said knife edge fitting into a diametrical slot cut into one end of the tube to be bent for indexing the side angle between a plurality of bends of said tube.

5. The combination with a tube bender, of a side angle indicator having a rotatable dial, a hollow shaft fixed to and supporting said dial, a tubular holder inserted in the front end of said shaft and secured thereto against relative movement, and a knife edge index diametrically attached to said holder, said knife edge being made in two parts spaced apart in the center for passage of a tube mandrel and fitting into a diametrical slot cut into one end of the tube to be bent for indexing the side angle between bends of the tube.

6. The combination with a tube bender, including a base, of a center pivot in said base, a bending block revolvable about said pivot, a bending lever turning said bending block about said pivot, an index segment provided with holes determining the bending angle, a removable pin put in one of said holes for stopping the bending lever from further movement, a side angle indicator spaced from the tube bender, having a rotatable dial, a shaft supporting the dial and indexing means diametrical to and attached to the front of said shaft for loosely engaging a diametrically slotted end of a tube to be bent for the purpose of indexing the side angle between bends of the tube.

7. The combination with a reversible tube bender, including a base, of a center pivot in said base, a lever turnable about said pivot, a bending lever adapted for bending a tube, a second pivot for swingably connecting one end of said bending lever with the free end of said first lever, means for releasably coupling said levers together into rigid relationship in two different positions, so that they can be swung as a unit about said center pivot for making right and left turn bends, respectively, an index segment concentric to said center pivot and provided with holes for marking the degrees of the bending angle, a pin to be inserted into one of said holes as a stop for said bending lever, a reversible bending block held in position by said two pivots, a vise slidable on said bending lever for clamping

the tube to be bent to the bending block, a fixed guide piece adjustable on said base, a second vise, including guiding rolls, slidable on said guide piece for guiding and holding the tube during bending against the bending block at a point substantially opposite its center, a side angle indicator, spaced from the tube bender and having a rotatable hollow shaft having a dial divided in degrees fixed thereto for indexing the side angle between two tube bends, and a knife edge, diametrically attached to one end face of the shaft, adapted to be inserted in a correspondingly placed slot cut into one end face of said tube.

8. The combination with a reversible tube bender, including a base, of a center pivot in said base, a short lever turnable about said pivot, a bending lever adapted for bending a tube, a second pivot swingably connecting one end of said bending lever with the free end of said short lever, means for releasably coupling said levers together into rigid relationship with each other so that they can be swung as a unit about said center pivot, an index segment attached to said base concentric to the center pivot and being provided with holes marking the degrees of the bend angle, and a removable stop insertable in one of these holes for arresting said bending lever.

9. The combination with a reversible tube bender, including a base, of a center pivot in said base, a short lever turnable about said pivot, a bending lever adapted for bending a tube, a second pivot swingably connecting one end of said bending lever with the free end of said short lever, and means releasably coupling said levers together into a rigid relationship in either one of two opposite positions so that they can be swung as a unit about said center pivot for making right and left turn bends, respectively.

10. The combination with a reversible tube bender, including a base, of a center pivot in said base, a short lever turning about said pivot, a bending lever adapted for bending a tube, a second pivot swingably connecting one end of said bending lever with the free end of said short lever, and a key inserted between straight faces of and releasably coupling said levers together into a rigid relationship with each other in two opposite positions so that they can be swung as a unit about said center pivot for making right and left turn bends, respectively.

11. The combination with a reversible tube bender, including a base having vise supports extending in opposite directions, of a center pivot in said base, a short lever turnable about said pivot, a bending lever, a second pivot swingably connecting one end of said bending lever with the free end of said short lever, means releasably coupling together said levers into rigid relation in either one of two opposite positions so that they can be swung as a unit about said center pivot for making right and left turn bends, respectively, a reversible bending block having a contour partly curved and partly straight and being held in position by said two pivots, a vise combined with said bending lever to clamp a tubing to be bent against the bending block, a second vise, including revolvable rolls, slidable and adapted to be fixed in various positions on said supports for guiding and holding the tube against the bending block at a point of same substantially where the straight part turns into the curved part.

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