A. J. REYNDERS.

TUBE BENDING MECHANISM.

APPLICATION FILED MAY 16, 1916.

1,238,941.

Patented Sept. 4, 1917.

2 SHEETS—SHEET 1.

FIG. 1.

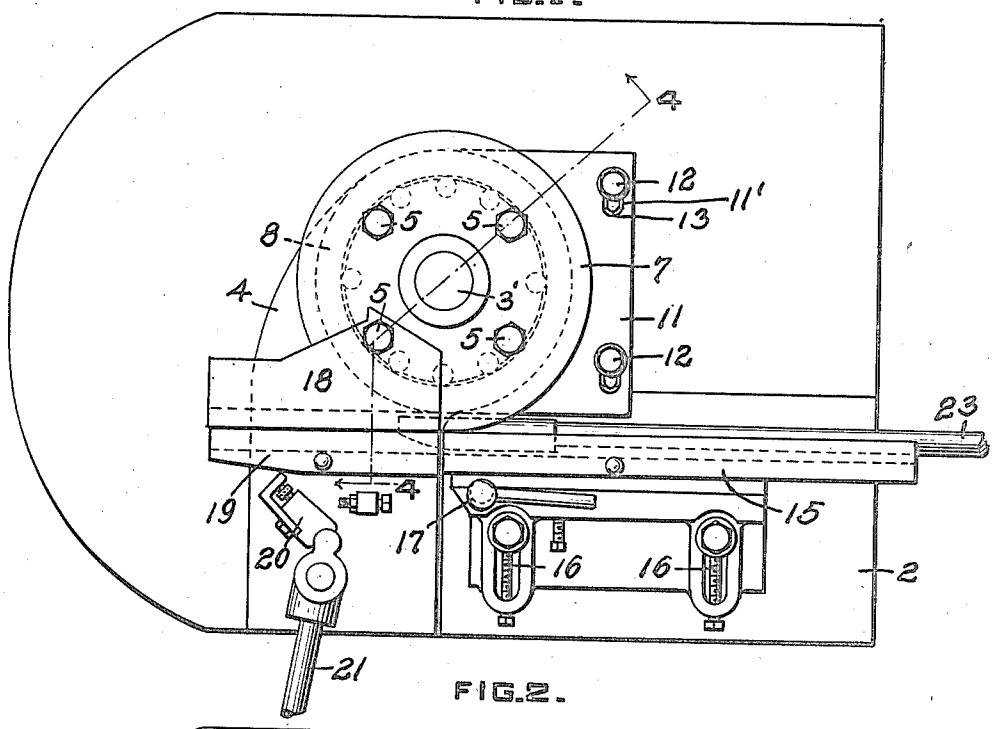
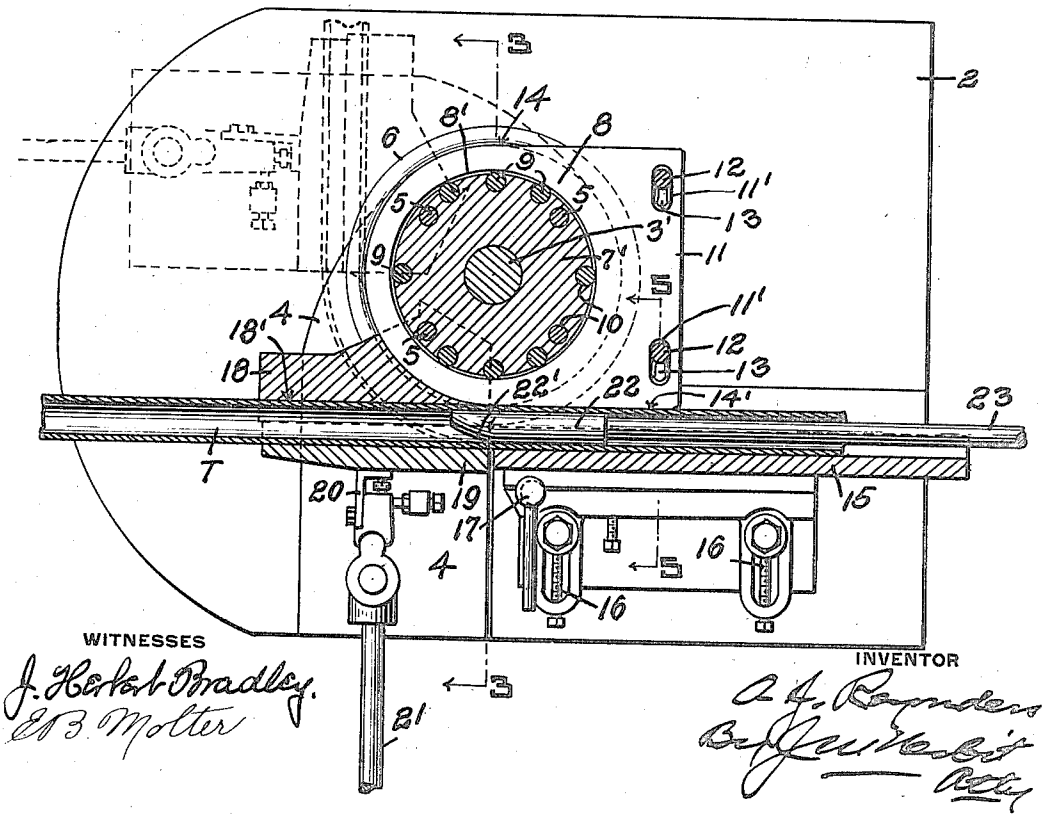


FIG. 2.



WITNESSES

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2 SHEETS—SHEET 2.

FIG. 3.

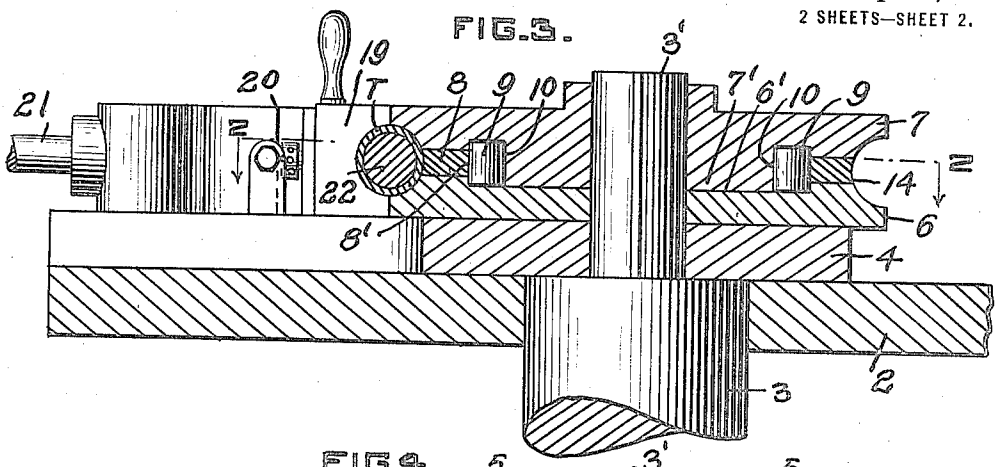


FIG. 4.

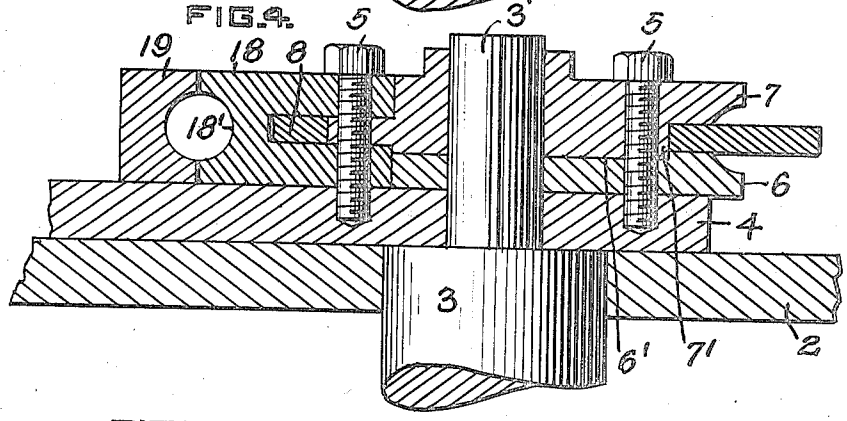
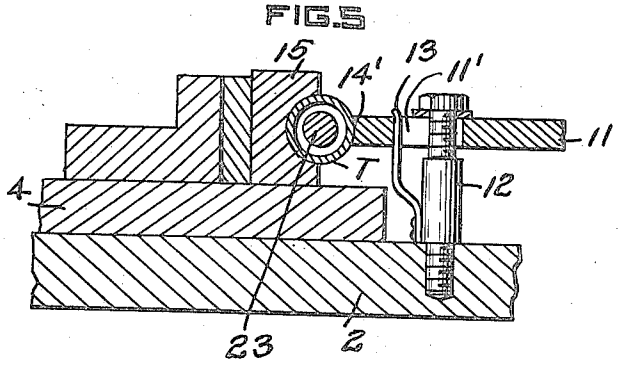


FIG. 5



WITNESSES

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UNITED STATES PATENT OFFICE.

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TUBE-BENDING MECHANISM.

1,238,941. Specification of Letters Patent. Patented Sept. 4, 1917.

Application filed May 16, 1916. Serial No. 97,823.

To all whom it may concern:

Be it known that I, AUGUSTUS JAMES REYNDERS, a citizen of the United States, and resident of Butler, in the county of Butler and State of Pennsylvania, have invented certain new and useful Improvements in Tube-Bending Mechanism, of which the following is a specification.

In the bending of tubing utilized in the production of metal bedsteads and other articles of furniture, hand rails, etc., it has heretofore been extremely difficult if not almost impossible to prevent the metal at the inner or concave side of the bend from crimping or developing other surface irregularities due to the compression of that portion of the metal and the corresponding stretching the convex side of the bend. The prevention of surface blemishes of this kind is greatly to be desired, particularly when the product is to be highly polished, imperfections being more apparent therein than, for instance, with unfinished steel tubing the surface of which is subsequently painted.

The object of this invention is to provide mechanism of novel construction by which the bending of tubing of all kinds is accomplished without developing crimps or other imperfections in any portion of the tubing, the inner or concave side of the bend being quite as smooth and free from blemish as the outer or convex side.

It is usual practice to secure tubing to a rotating former whereby during the bending operation the cold tubing is drawn around the former and given the desired curvature. The same general principle is involved in the present invention, but instead of rotating the entire former, it is divided into rotating and non-rotating parts arranged in close relation to each other and with the edges of said parts grooved complementary with the cross-sectional curvature of the tubing. The position of the non-rotating former part is such that the central portion of the concave side of the bend is drawn thereover during the bending operation, producing an ironing out or smoothing effect which operates to so work or spread the surface of the metal as to prevent the formation of irregularities of any kind. While it has been proposed heretofore to have the tubing withdrawn through a pass-like guide-forming passage as it is advanced by the bending operation, so far as I am aware I am the first to provide an ironing or smoothing out action that is effective throughout the peripheral length of the former, whereby the smoothing out or ironing action is had from end to end of the convex portion of the bend and throughout the entire bending period.

In the accompanying drawings, Figure 1 is a top plan view of a machine embodying the invention. Fig. 2 is a similar view, the bending mechanism and the tubing being shown in sectonal plan on line 2—2 of Fig. 3, the portion of said parts and the tubing at the completion of the bending operation being illustrated in dotted lines. Fig. 3 is a vertical section on line 3—3 of Fig. 2. Fig. 4 is a similar section on line 4—4 of Fig. 1. Fig. 5 is a sectional detail on line 5—5 of Fig. 2.

Referring to the drawings, 2 designates a fixed horizontal base or table that may be supported by any suitable means, not shown. Extending upwardly therethrough is the operating shaft 3 which may be driven in any convenient manner, and at the upper end of the shaft is spindle 3′ to which the rotating parts of the former or bender are secured, a plate 4 being interposed between the latter and base 2 and rotatable on the base.

Superposed on plate 4 and secured thereto by bolts 5 are the bottom sections 6 and top section 7 of the rotating portion of the former, said parts being keyed to spindle 3′. Part 6 is formed with top depression 6′ in which fits boss 7′ on the bottom of former part 7, with bolts 5 securing the fitted parts together and to plate 4, as shown in Fig. 4. The outer portions of parts 6 and 7 are spaced from each other, and closely fitting this space is the ring-like non-rotating part 8 of the former, the inner periphery 8′ of this part providing a bearing for rollers 9, the latter confined in suitable sockets 10 in the periphery of boss 7′. The rollers are slightly shorter than the depth of the boss and hence are loosely confined by the connected parts 6 and 7. With the former mechanism thus assembled, the non-rotating part 8 is accurately held to position with reference to the rotating parts 6 and 7, the bearing rollers insuring a close and accurate

fit and at the same time affording free movement of the rotating parts with reference to the non-rotating part.

The non-rotating former part 8 is extended rearwardly at 11 to provide a guide at an edge thereof, also to provide means for securing said part to base 2 against rotation. As here shown the securing means consists of two post-like bolts 12 projecting from base 2 through slots 11′ in extension 11, thereby affording the latter slight play in a direction to exert pressure on the tube in advance of the bending point, as will be presently explained, this pressure being provided by leaf springs 13 secured to posts 12 entered in slots 11′.

Former parts 6 and 7 are curved concentrically about spindle 3, and the non-rotating part 8 is similarly curved, excepting the rearward extension 11 thereof. Former parts 6, 8 and 7 are in superposed relation in the order named, as clearly shown in Fig. 3, and the edges thereof are grooved at 14 in conformity with the cross-sectional curvature of the tubing T being operated upon. The extremity portions of groove 14 are formed in sections 6 and 7, respectively, while the intermediate portion is formed in the edge of the non-rotating part 8. The edge groove in part 8 is continued to the rear extremity of the guide-forming extension 11, as indicated at 14′ for engaging the tube opposite abutment 15, the latter and extension 11 forming, in effect, a guiding pass through which the tube feeds as it is drawn forward during the bending operation. Abutment 15 is held in place by clamp devices 16 and the eccentric clamp 17, as usual in this type of machines.

The tubing is secured to the rotating former elements by means of jaws 18 and 19, the extremity of jaw 18 being bifurcated to embrace the non-rotating former part 8 and to fit recesses in the upper and lower rotating former parts, being secured thereto by one of screws 5. And with jaw 18 secured to the rotating former it is of course rigid with plate 4. Jaw 19 is removably positioned on plate 4 and in embracing engagement with the tubing in opposition to jaw 18, the hold of the jaws on the tubing being maintained by clamp 20 carried by plate 4 and adapted to be locked and released by lever 21.

During the bending operation the tubing is drawn over a mandrel 22 which is so located in the above defined guiding-pass formed by parts 11 and 15 that the inception of the bend occurs at the beveled or rounded extremity 22′ of the mandrel. The mandrel is secured to an anchor rod 23 in the usual manner.

Operation: The tubing to be bent is entered over the mandrel when the parts are in the position shown in Fig. 1, clamp jaw 19 being relaxed, likewise abutment 15 of the guiding-pass. After the tube has been so positioned as to cause the bend to be formed at the proper point in the length thereof, the clamps are set up, thereby securing the tubing to the grooved edge 18′ of jaw 18, grooved edge 14′ bearing tightly against the tubing in line with and forming practically a continuation of groove 18′ at a point where said grooves merge into groove 14 of the former. The former sections 6 and 7 together with the clamp carried by plate 4 are then slowly rotated through the medium of spindle 3, and for a right angle bend are carried to the position shown by dotted lines in Fig. 2, during this operation the tube being drawn through the guide-forming pass and over mandrel 22 and around the rounded extremity 22′ of the latter. During this operation the rotating parts of the former turn freely within the non-rotating former part 8, this action being facilitated by the bearing rollers, as will be understood.

During the bending operation the tubing is drawn around and over the grooved edge of the non-rotating former part, a considerable area of the inner or concave side of the tube being in engagement with this part while the remainder of such side engages and moves with those portions of grooves 14 formed in rotating parts 6 and 7. This intermediate non-rotating former part has the effect of smoothing or ironing out the convex face of the tubing bend in such manner as to eliminate crimps and other irregularities that might otherwise form therein as a result of the contraction of the metal at the bend. But the presence of this non-rotating former part in no way interferes with the bending operation, the portions of groove 14 carried by former parts 6 and 7 being quite sufficient to do all the work that is required of a rotating forming or bending element. A further characteristic of the invention is the tension maintained on the tubing in the guide-forming pass by the grooved edge 14′ of extension 11 of the non-rotating former part, whereby the tubing is tightly and accurately held while passing to and over the mandrel. In fact, the smoothing or ironing-out action has its inception at the extremity of extension 11, and this effect is active throughout the length of said extension as well as throughout the curved portion of former 8 where the bending action takes place.

While the invention is here shown adapted for producing right angle bends, it will be understood that bends of other forms may be produced without departing from the invention. Tubing of various sections may be operated upon by providing different sets of former parts grooved conformably to the size of the tubing to be operated upon.

I claim—

1. In a tube bending machine, the combination of a former consisting of rotating and non-rotating parts arranged adjacent each other and having working faces concentrically curved, and means for securing the tubing to the working face of the rotating portion of the former whereby the tubing is drawn over the working face of the non-rotating former part.

2. In a tube bending machine, the combination of a former consisting of parallel rotating and non-rotating parts arranged adjacent each other and having corresponding convex edges with said edges shaped complementary with the cross-sectional curvature of the tubing, the non-rotating portion of the former extended from said convex edge portion to provide a guide for the tubing and with the edge of said guide forming portion shaped to fit the tubing, and means for securing the tubing to the rotating portion of the former, whereby during the bending operation the tubing is drawn over the grooved edge of the guide as well as over the grooved edge of the non-rotating former part.

3. In a tube bending machine, the combination of a former consisting of parallel rotating and non-rotating parts arranged adjacent each other and having corresponding convex edges, the non-rotating former part having a guide-forming extension, the convex edges of the former parts and the edge of said guide-forming extension being grooved complementary with the cross-sectional curvature of the tubing, an abutment coöperating with said guide-forming extension to provide a pass for the tubing, said non-rotating former part being adapted to oscillate relatively to the abutment, tension means for holding said guide-forming extension pressed toward the abutment and in close engagement with the tubing, and means for securing the tubing to the rotating portion of the former, whereby the tubing is drawn through said pass and over the grooved edge of the non-rotating former part.

4. In a tube bending machine, the combination of a former consisting of parallel rotating parts and an interposed non-rotating part, all of said parts having corresponding convex edges with said edges grooved complementary with the cross-sectional shape of the tubing, the interposed non-rotating former part having a guide-forming extension, the edges of all of said parts grooved complementary with the cross-sectional curvature of the tubing with the grooving of the non-rotating part extending over its guide-forming extension, an abutment with which said extension coöperates to provide a pass for the tubing, tension means exerting pressure on the guide-forming extension for holding it in close engagement with the tubing, and means for securing the tubing to the grooved portions of the rotating former parts, whereby the tubing is drawn through said pass and over the grooved edge of the non-rotating former part.

5. In a tube bending machine, the combination of a former consisting of parallel rotating former parts and a non-rotating former part interposed between said rotating parts, the non-rotating part having a circular opening with the wall of such opening providing a bearing surface, the rotating former parts fitted one to the other through said opening, bearing rollers confined by the said fitted parts for engaging the bearing surface provided by the opening, the edges of the rotating and non-rotating former parts being shaped complementary with the cross-sectional shape of the tubing, and means for securing the tubing to the rotating portions of the former, whereby during the bending operation the tubing is drawn over the edge of the non-rotating former part.

6. In a tube bending machine, the combination of a former consisting of parallel rotating former parts and an interposed ring-like non-rotating part, one of the rotating parts having a circular boss extending through said ring-like part and engaging the other rotating former part, bearing rollers confined by the periphery of said boss and adapted to engage the inner periphery of said ring-like part, securing devices uniting the rotating former parts and confining them and said rollers relative to the non-rotating former part, all of said former parts being correspondingly curved relatively to the axis of the rotation and the edges of said parts grooved complementary with the cross-sectional curvature of the tubing, and means for securing the tubing to the rotating former parts, whereby during the bending operation the tubing is drawn over the grooved edge of the non-rotating former part.

7. In a tube bending machine, the combination of a base, a former mounted on said base and consisting of parallel rotating and non-rotating former parts arranged adjacent to each other and correspondingly curved relatively to the axis of rotation, the edges of the former parts being grooved complementary with the cross-sectional curvature of the tubing, the non-rotating former part having a rearward guide-forming extension provided with vertically disposed slots, posts projecting from the base into said slots and springs within the slots to hold said non-rotating part under tension, an abutment toward which said springs press said guide-forming extension and hold the tubing pressed against said abutment, and means for securing the tubing to the ro-

tating portion of the former, whereby during the bending operation the tubing is drawn over the grooved edge of the non-rotating former part.

8. In a tube bending machine, the combination of a former consisting of rotating and non-rotating parts arranged adjacent each other and having working faces concentrically curved, and means for causing the tubing to move with the working face of the rotating former part and move over the working face of the non-rotating part.

In testimony whereof, I affix my signature in presence of two witnesses.

AUGUSTUS JAMES REYNDERS.

In presence of—

ANDREW T. MOONZEL,

HARRY L. GRAHAM.