April 7, 1959 R. P. MINGORI 2,880,779

TUBE BENDING MACHINE HAVING RECIPROCATING AND PIVOTED BENDERS

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Fig.1

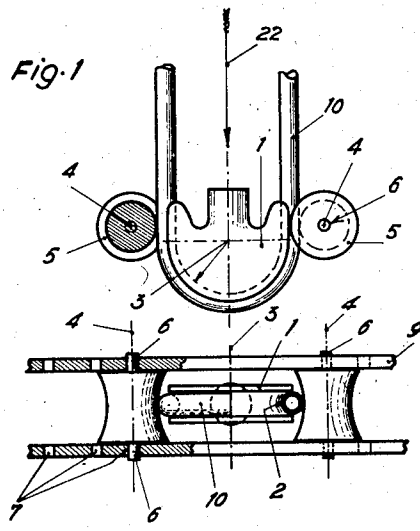


Fig.2

Fig.3

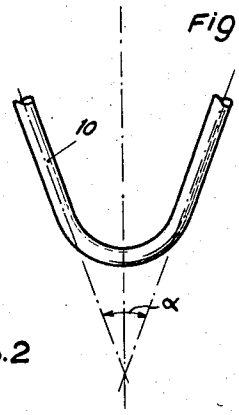


Fig.4

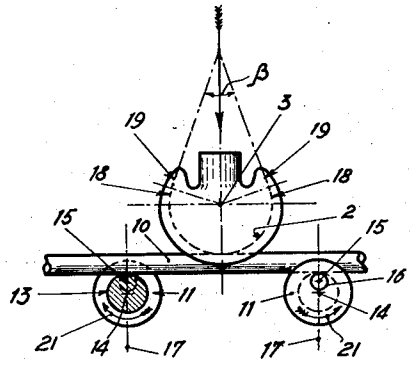


Fig.5

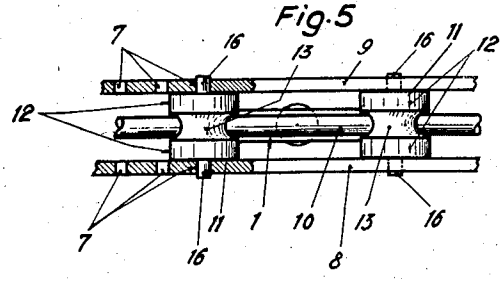
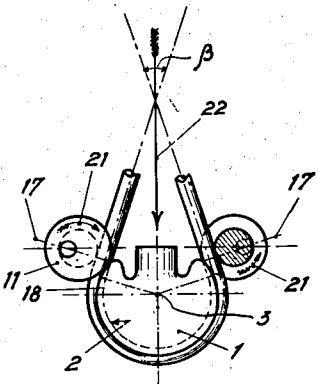


Fig.6



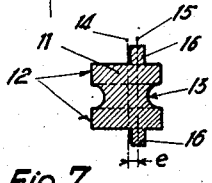


Fig.7

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TUBE BENDING MACHINE HAVING RECIPROCATING AND PIVOTED BENDERS

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Claims priority, application France May 21, 1954
4 Claims. (Cl. 153—33)

The present invention relates to machines for bending tubes while cold and not filled with any material.

In machines of this type use is made of a rounded pressing shoe having a groove extending over at most 180° and which presses the tubes to be bent, against and between two lateral rollers having a hollow groove wide enough for accommodating tubes of various diameters. The groove of said rollers, at least in its operative portion, is of revolution about the axis of two coaxial journals, adapted to maintain each roller in place and to rotate in holes of two plates connected to the pressing shoe operating device.

This operating device may be a mechanical screw-jack or a hydraulic jack, the rod of which is adapted to push the pressing shoe toward and between the two lateral rollers, in order to bend a tube inserted between said shoe and rollers.

Even when use is made of a pressing shoe **1** having a groove **2** extending over an arc somewhat in excess of 180° while causing the pressing shoe to progress far enough i.e., with its axis **3** reaching a position beyond the plane of the axes **4** of the two lateral forming rollers **5** (Figs. 1 and 2) with coaxial journals **6** rotating in holes **7** of plates **8** and **9**, it is true that the tube **10** is brought, in the course of the bending operation, into a 180° bent hair-pin shape but, as soon as it is released from the machine it springs back to some extent and assumes a V-shape. The non-bent portions of the tube form an acute angle α which is of the order of 2° to 5°. Finally, instead of a bend angle of 180°, values of 175° to 178° are generally not exceeded.

Fig. 3 shows the tube when released after bending at 180°, the representation of the angle α being purposely exaggerated.

Bending tubes at strictly 180° was heretofore, seldom required. However, for circulation heating of floors, ceilings, or walls, it is now desirable to obtain 180° bends for parallel arrangement of the rectilinear portions of the tubes between the bends.

The object of the present invention is to provide a bending machine which does not have the drawbacks hereinabove mentioned.

According to the principal feature of the invention, the operative portion of said lateral rollers move toward each other as the front portion of the pressing shoe passes the plane which contains the axes of said lateral rollers, and the rear portion of the pressing shoe tapers rearwardly.

According to another feature of the invention, the lateral rollers forming surfaces move nearer each other due to a particular structure of the rollers themselves, namely the operating portion or forming surface of each roller is eccentric with respect to the axis of the roller journals, whereby the tube to be bent is in contact with the roller portions of minimum eccentricity when the bending operation is being initiated and with the roller portions of maximum eccentricity at the end of said

bending operation. The rollers being rotated by the relative movement of the tube relative to the rollers.

Other and further objects and advantages of the invention will be apparent to those skilled in the art, from a consideration of the following description of one embodiment of the invention, shown by way of example in the accompanying drawings, in which:

Fig. 1 is a plan view of the conventional pressing shoe and rollers adapted for bending a tube 180°.

Fig. 2 is a corresponding elevational end view.

Fig. 3 shows the tube when released having a bend angle smaller than 180°, owing to its elasticity.

Fig. 4 shows, in plan view, the pressing shoe and rollers according to the invention in contact with the tube to be bent prior to bending.

Fig. 5 is a corresponding end elevational view.

Fig. 6 shows, in plan view, the completion of the bending operation at the moment when the tube is brought to maximum bend $180°+\beta$ in the bending device, and

Fig. 7 is an axial section of a lateral roller through the plane of maximum eccentricity.

In these figures, like parts are identified by like numbers.

Figs. 1, 2 and 3 have been described in the introduction and relate to a conventional bending device.

In Figures 4, 5, 6 and 7 the lateral rollers **11**, according to the invention, are different from the conventional lateral rollers **5** (Figs. 1 and 2) which are of revolution about their axis **4** and provided with coaxial journals **6**. Furthermore, the groove of the conventional rollers assumes any concave shape and extends all over the height thereof.

As a contrast, the lateral rollers **11** according to the invention (Figs. 4, 5, 6, 7) have a cylindrical outer surface **12** provided with a semi-circular groove **13**, the cross-section of which corresponds to the outer diameter of the tube **10** to be bent.

The surfaces **12** and **13** have, for example, a common axis of revolution **14** which is not the same as the axis **15** of the journals **16** of the roller adapted to rotate in the holes **7** of the plates **8** and **9** of the bender.

The axes **14** and **15** are spaced from each other by a distance of eccentricity e in an axial plane **17** (Figs. 6 and 7).

The pressure shoe or forming element **1** may be of a conventional type with a groove suitable for various tube diameters, provided it is able to pass between the rollers **11**.

In the conventional design (Fig. 1) the rear portions of the groove of the pressing shoe form parallel extensions of the semi-circular front groove **2**. As a contrast, according to the invention, the rear portions of the pressing shoe (Fig. 4) comprise circular arcs **18** extending about over 2° to 5° merging into two rectilinear portions **19** forming an angle β. The tube, thus, will be over bent by this angle β and, when it leaves the bender, it springs open the same angle β which corresponds to its own elasticity, so that its branches lie parallel with each other.

It will also be advantageous to give to the groove **2** the outer profile of the tube with, if need be, edges surrounding the latter over about the depth of the radius and progressively decreasing rearwardly in order to facilitate the passage of the pressing shoe pad **1** between the lateral rollers.

Fig. 4 shows the beginning of the bending operation, with the lateral rollers and the central pressing shoe in contact with the straight tube **10**. At this stage, the rollers are in contact with the tube by their point of least eccentricity on the diameter **17**. They are rotatively driven in the direction of the arrows **21** when the shoe **1**

moves forwardly in the direction of the arrow 22 (Fig. 6) while the tube is being bent.

When the operation is completed if the dimensions of the shoe and rollers are adequate, the rollers are in contact with the tube at the other end of the diameter 17, i.e., at the point of maximum eccentricity. Under these conditions, the tube is resiliently distorted with its branches making together the angle β (Fig. 6). This angle is purposely very much exaggerated in the diagram, actually it amounts only to a few degrees.

As many changes could be made in the above construction, and many apparently widely different embodiments of this invention could be made without departing from the scope of the claims, it is intended that all matter contained in the above description or shown in the accompanying drawings shall be interpreted as illustrative and not in a limiting sense.

Thus, the groove of each lateral roller might not be of revolution and the bottom of this groove might follow a curve the distance of which to the axis of the journals varies differently than the distance between the cylindrical surface of the roller and the axis of the journals.

What I claim is:

1. In a tube bending apparatus, in combination, two laterally spaced eccentrically mounted rotatable bending rollers each having annular substantially concentric working surfaces of channeled cross-section adapted to receive a tube when overlying the rollers and spanning the space between said rollers, reciprocable means comprising an arcuately channeled forming element movable into engagement with the tube and adapted to execute a working stroke between the rollers thereby to bend in cooperation with said rollers opposite sections of the tube rearwardly of a leading end of said element, said forming element having a leading portion provided with substantially concentric working surfaces of channeled cross-section defining a semi-circle and a trailing portion integral with the leading portion forming a continuation thereof, the trailing portion having arcuate working surfaces of channeled cross-section symmetrically disposed on opposite sides of a longitudinal axis of the element and each defining an arc of substantially 2°, each arc being a continuation of said semi-circle, said rollers having eccentric pivotal axes disposed laterally of each other in substantially a common plane and each roller being adapted to be disposed with the portion of the channel working surface disposed at a minimum radius from its associated pivotal axis engaging the tube at the start of the working stroke and each roller being freely mounted and disposed so that it can be turned angularly by a tube of particular character to cause the working surface disposed at a maximum radius from its associated pivotal axis to cooperate with the forming element substantially at the end of the working stroke to bend the straight portions of the tube inward toward each other to compensate for springback.

2. A tube bending apparatus according to claim 1, in which the working surfaces of the trailing portion terminate on opposite sides of said longitudinal axis and include working surface portions of channeled cross-section on opposite sides of said axis extending in a direction tangentially of the working surfaces defining said 2° arcs and as extensions thereof.

3. In a tube bending apparatus, in combination, two laterally spaced eccentrically mounted rotatable bending rollers each having channeled, annular working surfaces adapted to receive a tube when overlying the rollers and spanning the space between said rollers, reciprocable means comprising a forming element movable into engagement with the tube and adapted to execute a working stroke between the rollers thereby to bend opposite sections of the tube rearwardly of the leading end of said element in cooperation with said rollers, said forming element having a longitudinal axis and arcuate substantially concentric working surfaces of channeled cross-section disposed on opposite sides of said longitudinal axes and said arcuate working surfaces defining an arc greater than 180°, said rollers having eccentric pivotal axes disposed laterally of each other in substantially a common plane and each roller being adapted to be disposed with the portion of the channel working surface disposed at a minimum radius from its associated pivotal axis engaging the tube at the start of the working stroke and each roller being freely mounted and disposed so that it can be turned angularly by a tube of particular character to cause the working surface disposed at a maximum radius from its associated pivotal axis to cooperate with the forming element substantially at the end of the working stroke to bend the straight portions of the tube inward toward each other to compensate for spring back.

4. A tube bending apparatus according to claim 3, in which the working surfaces of each of the rollers and of said element each define a channel having a cross-section corresponding to the registering cross-section of the tube bent in the apparatus.

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