(No Model.)

R. CLARKE.

METHOD OF AND MACHINE FOR BENDING TUBES.

No. 506,157. Patented Oct. 3, 1893.

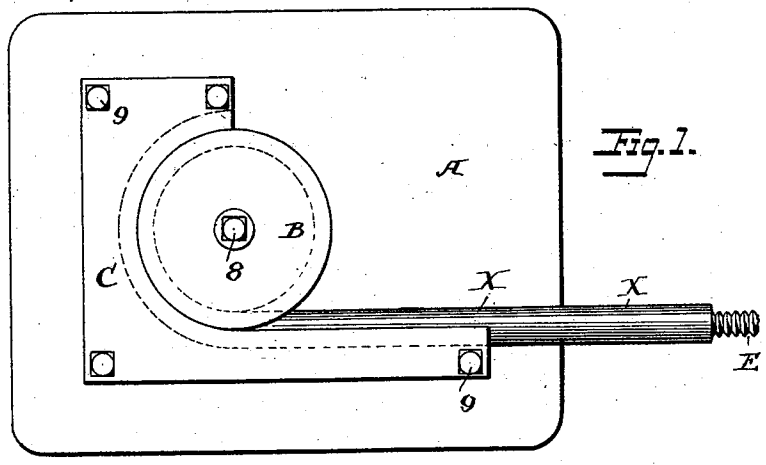

Fig. 1.

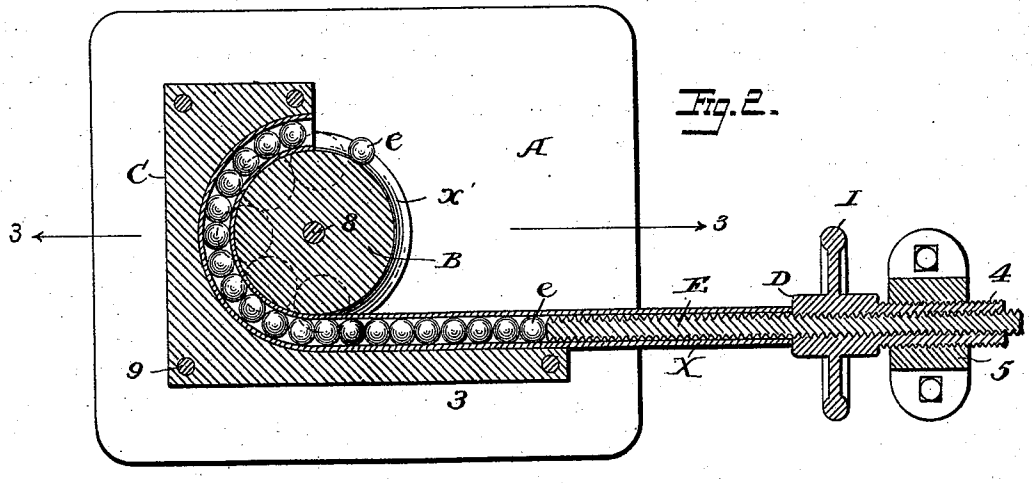

Fig. 2.

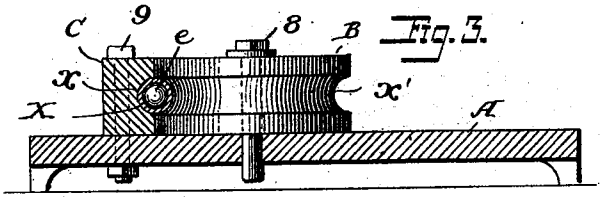

Fig. 3.

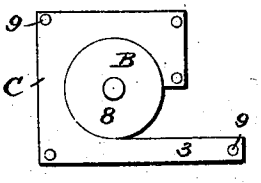

Fig. 4.

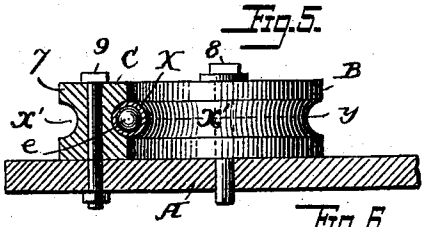

Fig. 5.

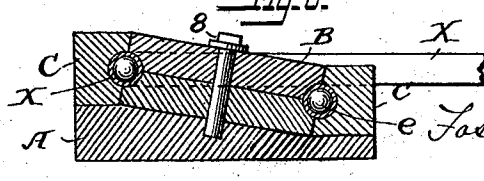

Fig. 6.

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UNITED STATES PATENT OFFICE.

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METHOD OF AND MACHINE FOR BENDING TUBES.

SPECIFICATION forming part of Letters Patent No. 506,157, dated October 3, 1893.

Application filed March 1, 1893. Serial No. 464,242. (No model.)

To all whom it may concern:

Be it known that I, ROBERT CLARKE, residing in Sheepshead Bay, (P. O., Gravesend,) Kings county, New York, have invented certain new and useful Improvements in Methods of and Machines for Bending Tubes, of which the following is a specification.

My invention relates to methods of and apparatus for making bent tubes of different metals, as for instance, such tubes as are used for hand rails, boiler tubes, traps, &c., and my invention consists in bending said tubes by forcing them into suitably formed channels in molds, while at the same time forcing through the tubes and at a greater rate of speed, a series of hard metal spheres, as fully set forth hereinafter and as illustrated in the accompanying drawings, in which—

Figure 1 is a plan view illustrating the apparatus employed in carrying out my invention; Fig. 2, a sectional plan of the said apparatus, showing also the forcing means. Fig. 3 is a section on the line 3—3, Fig. 2. Fig. 4 is a plan showing a different form of die. Fig. 5 is an elevation also showing a different form of die; Fig. 6, a sectional elevation, showing a die as used for curving spiral tubes.

The operative parts of the bending apparatus are mounted upon a base, A, of any suitable construction, said operative parts consisting essentially of die sections having between them an opening or channel corresponding to the form to be imparted to a tube. According to the purpose to which the bent tube is to be applied, this form may correspond to a part of a circle lying all in one plane, or it may conform to a spiral as is requisite in bending tubes to a spiral form for boilers, &c., or the curve instead of being circular may correspond to part of an ellipse or oval as circumstances require.

It will be evident that the form and construction and arrangement of the die sections will depend upon the form to be imparted to the tube, but there is generally an inner section, B, and an outer section C, and I prefer to make the inner section in the form of a wheel having an annular groove at the periphery and the section C, whatever its form, will also have a groove so as to form with the groove in the section B, a channel of the proper shape.

As shown in Figs. 1, 2 and 3, the section C is a block recessed to receive about one-half the diameter of the wheel section B and conforming to the periphery of the latter, and having in the part opposite the said periphery, a groove x which in connection with the groove x' of the section B constitutes a cylindrical channel for the reception of the pipe. A projection 3 of the section C has a groove constituting a guide channel into which the pipe X is placed and along which it is pushed toward the channel $x\,x'$. The tube X is forced into the channel x, x' by any suitable pressure appliances, but it would be evident that merely pushing the said tube endwise into said channel would not result in forming a perfect bend, that is, the tube would be creased and wrinkled, if not flattened in the effort to push it through the curved channel. I therefore provide for means for maintaining the cylindrical form of the tube notwithstanding the pressure and the variations of pressure which must be put upon it in forcing it through the channel, the same consisting in inserting in the tube a number of spheres e, preferably of hardened steel, and which accompany the tube in its movements through the channel and which are withdrawn after the tube has been properly bent. I have discovered that if the spheres are pushed with the tube at the same speed at which the latter moves, the bending is not perfectly accomplished, but on the contrary, the tube is wrinkled and distorted so that it is difficult to remove the spheres after the bending has been effected. I therefore provide means whereby the spheres are caused to travel through the tube at a greater speed than that at which the tube is introduced into the channel, so that the spheres have a sort of a rolling action tending to flatten and draw out the metal and preserve the absolute cylindrical form of the interior of the tube, notwithstanding the variations in the strain at different parts of the tube. While different means may be employed for imparting this difference in motion of travel to the tube and to the internal spherical balls or mandrels, I have found that an effective means of operation consists in forcing the tube into its channel by means of a hollow plunger D, moving at the proper rate of speed and in forcing the series of balls

through the tube by means of a solid cylindrical plunger or rod E traveling at a higher speed than that of the plunger D. The sections B, C of the die are each separable from the base A, the wheel or disk B being held by a detachable bolt or pin 8 and the section C by bolts or pins 9. Various means for imparting this differential movement to the two parts will be evident to any one skilled in the art. As shown in Fig. 2, the said means consists of a hand wheel I, the hub D of which is hollow and constitutes the hollow plunger D upon which the ends of the tube X bear, a hollow tubular extension 4 of the plunger D having threads fitting a threaded opening in a standard 5, the threads being at such a pitch that the revolution of the wheel I will impart the requisite degree of traveling movement to the hub or plunger D. The plunger D and the tubular extension 4 are also threaded with a pitch very much greater than that of the extension 4 and adapted to the threads upon the plunger E, so that when the wheel is turned it will impart to the plunger E a quick, forward, traveling movement, and the wheel itself will also travel forward in its bearing 5 but at a much less rate of speed. The difference between the speed of one plunger and the other may be any difference which is found most effective. As a general thing, I find that a difference of five to one will, in many cases, be sufficient; but it may be greater or less as circumstances demand. The construction illustrated in Figs. 1, 2 and 3 will suffice where the tube is to be bent to anything less than a half circle, or where it is to be bent to a full circle, the section C should extend completely around the section B of the die, as illustrated in Fig. 4; and where the tube is to be bent to a spiral form, the section B is set at an angle to part of the section C, as illustrated in Fig. 6. It is not necessary that the section C should be a solid block; it may consist of a series of grooved rollers, 7, as illustrated in Fig. 5, and the section B itself may consist of a series of grooved rollers as illustrated in dotted lines, Fig. 2. Where the section B consists of a wheel, it may be divided longitudinally into two sections upon the plane illustrated by dotted lines *y*, Fig. 5, so that if more pressure comes upon one section or the other, such section may move more readily or at a greater speed than the other, and when the outer section consists of grooved rolls 7, they may likewise be divided centrally upon the same plane.

Without limiting myself to the precise construction and arrangement of parts shown, I claim—

1. The within described improvement in the manufacture of bent metal tubes, the same consisting in pushing the tube under endwise pressure into a curved channel and at the same time pushing through the tube at a greater speed a series of spheres, substantially as set forth.

2. The combination in a machine for making curved metal tubes, of a die consisting of two sections having a curved channel between them for the reception of the tube to be bent, a series of spheres arranged within the tube to be bent, and means for pushing the tube through the channel at one speed and the spheres through the tube at a greater speed, substantially as set forth.

3. The combination with the dies B, C, of a tube bending machine, and with a series of spheres adapted to be arranged within the tube to be bent, of two plungers, one arranged to bear against the tube and the other arranged to bear against the spheres, and means for imparting to both plungers a forward movement, one in excess of the other, substantially as set forth.

In testimony whereof I have signed my name to this specification in the presence of two subscribing witnesses.

ROBERT CLARKE.

Witnesses:
C. MOORHEAD,
JOSEPH H. SAUNDERS.