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APPARATUS FOR BENDING TUBES.

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1,099,669.

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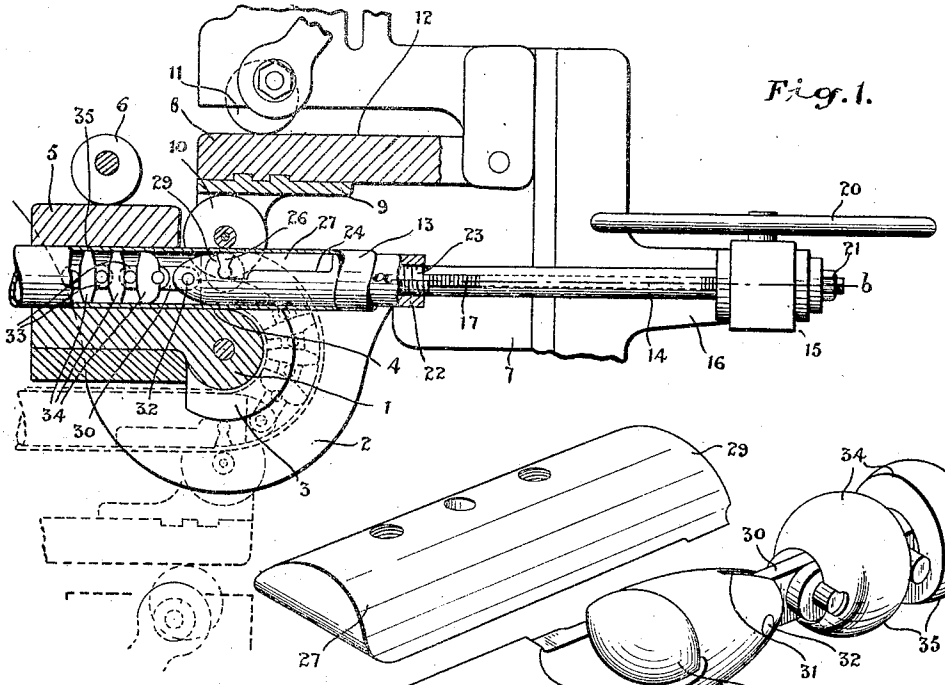


Fig. 1.

Fig. 2.

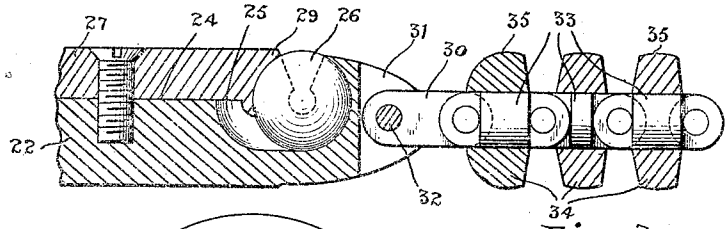


Fig. 3.

Fig. 5.

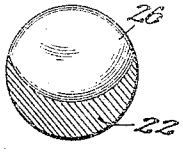
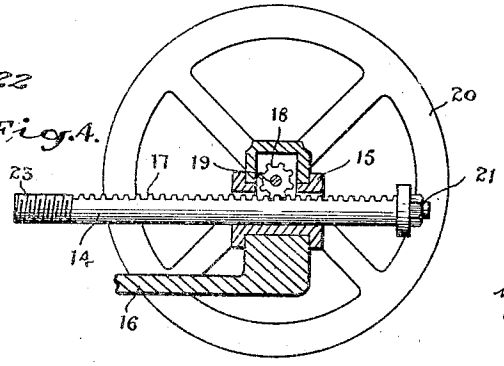


Fig. 4.



Witnesses.

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APPARATUS FOR BENDING TUBES.

1,099,669. Specification of Letters Patent. Patented June 9, 1914.

Application filed April 21, 1913. Serial No. 762,519.

To all whom it may concern:

Be it known that I, JOHANNES RUCKSTINAT, a citizen of the United States of America, and resident of the city of Toronto, county of York, Province of Ontario, in the Dominion of Canada, have invented certain new and useful Improvements in Apparatus for Bending Tubes, described in the following specification and illustrated in the accompanying drawings, that form part of the same.

The objects of the invention are, to reduce the cost of manufacture of bends of thin tubing and to devise an apparatus for making such bends cold and in one operation producing a bend of uniform dimensions with a smooth and regular surface.

The principal feature of the invention consists in the novel construction of the forming mandrel whereby the metal of the tube is rolled out in the bending operation and any slight inequalities in the rolling operation are effaced by a flexible follower.

In the drawings, Figure 1 is a plan sectional view of a portion of the table of a bending machine showing the forming block and tube holding means and the means for rolling out the tube. Fig. 2 is an enlarged perspective detail of the mandrel showing the cap for holding the swaging roller in place removed. Fig. 3 is a longitudinal sectional view of the roller end of the mandrel and a portion of the flexible follower. Fig. 4 is a vertical sectional view through the line *a—b* Fig. 1, the rod being shown in a slightly different position. Fig. 5 is a cross sectional view through the mandrel taken on the axis of the swaging roller.

Like numerals of reference indicate corresponding parts in each figure.

Referring to the drawings, 1 is the stationary forming block which is rigidly secured to the table 2 of the forming machine, a portion only of which is shown, the construction thereof being fully described in my former United States Patent No. 1,055,358.

The forming block is constructed with a peripheral groove 3 of semi-circular cross section extending from the straight side 4 thereof and conforming to the diameter of bend of tube required.

5 is a clamping block formed with a horizontal grooved face and adapted with the forming block to grip the tube to be bent, a cam 6 being herein shown engaging said clamping block.

7 is a portion of the rotatable table adapted to rotate about the center of the forming block, the means of supporting and rotating same being fully shown in my former United States patent above mentioned.

8 is an arm pivotally supported from the rotatable table 7 having a jaw-shaped block 9 secured on its outer face and carrying a grooved swaging roller 10 in the jaw, said grooved roller having its peripheral face shaped to conform to half the circumference of the tube to be bent.

11 is a cam supported in the table 7 and engaging the outer face 12 of the arm 8 and adapted to force the roller 10 into operating contact with the tube 13 clamped against the forming block.

14 is a rod slidably supported in a sleeve 15 secured to the extension bracket 16 of the rotatable table 7, said rod having a spur tooth rack 17 formed on its upper face.

18 is a spur pinion secured to a spindle 19 suitably journaled in the bracket 16 above the rod 14 and meshing with the rack 17.

20 is a hand wheel secured to the outer end of the spindle 19 adapted to rotate said spindle and pinion to move the rod 14 longitudinally in its supporting sleeve. A suitable stop collar and adjustable nut 21 is provided at the outer end of the rod 14.

22 is the mandrel formed of a cylindrical bar of steel of a diameter to fit loosely into the interior of the tube to be bent. The mandrel 22 is threaded upon the threaded end 23 of the rod 14 and the opposite end thereof is tapered in arc shape to conform to the arc of the circle of the outer radius of the inside of the tube when bent around the forming block.

24 is a recess cut in one side of the mandrel adjacent to the tapered end having a depression at the forward end forming a transverse cupped recess 25. This recess is of peculiar formation being of arc-shape in transverse section, the arc thereof conforming to the outer diameter of the mandrel and extending outwardly to the perimeter of the mandrel, the axis thereof being in alinement with the point of juncture of the tapered end and the parallel portion of the mandrel.

26 is a roller shaped to conform to the cir-

cumferential arc of the transverse section of the mandrel and adapted to fit snugly into the cupped recess 25.

27 is a cap closing the recessed portion 24 of the mandrel and having the forward end thereof recessed to conform to the shape of the roller 26 holding said roller securely in place and allowing it to turn freely. The cap is secured in position by means of suitable screws inserted in the threaded holes 28. The forward edge 29 of the cap 27 is cut away at an incline to leave a portion of the roller projecting clear of the mandrel. A rolling contact is thus provided between the inner surface of the tube on the outer circumference of the bend and the engaging surface of the mandrel. The rod 14 is adjusted so that the axis of the roller 26 will be arranged in direct alinement between the axis of the forming block and the axis of the swaging roller 10 and as the rotatable table 7 is swung around the forming block, the metal of the outer half of the tube will be swaged by the rolling contact of the rollers 10 and 26.

It will be noted that in swaging the tube the metal of the extreme outer diameter of the bend is rolled to the greatest length and from the outer central point the swaging gradually diminishes to a practically neutral point at the transverse diameter of the tube. The peculiar shape of the roller 26 with the outer roller 10 conforming to the transverse curve of the tube thus effects a gradually diminishing swaging from the outer diameter inward and the metal is thus rolled or swaged to the desired shape without an undue stretching which would cause distortion of the transverse shape of the tube.

Any desired pressure may be placed upon the roller 10 by means of the cam 11 so that the metal will be rolled out and will not be drawn.

30 is a link extending into a transversely arranged slot 31 formed in the apex of the tapered end of the mandrel being pivotally secured upon the pin 32.

33 are a plurality of cylindrical shaped links connected to the link 30.

34 are disk shaped members secured upon the links 33 and having the peripheral faces 35 formed of a spherical shape corresponding in diameter to the diameter of the mandrel. These links and disks form a flexible follower for the mandrel and obviate any tendency there might be in the metal of the tube collapsing on the outer side as it is being bent.

In the use of this device the operator places the tube to be bent between the forming and clamping blocks and then inserts the flexible end of the mandrel and by operating the hand wheel forces it inwardly to its innermost position as regulated by the stop collar 21, the roller 26 being in radial alinement with the axis of the forming block. The cam 11 is then turned to move the swaging roller into engagement with the tube and the rotatable table is then swung upon its axis bending the tube around the forming block and rolling the metal of the outer half thereof between the roller surface of the mandrel and the swaging roller. The flexible follower is drawn after the mandrel and following closely the curved tapered end thereof prevents the metal from collapsing and rectifies any slight indentations there might be.

When the rotatable table has been moved the desired distance to form the bend the operator rotates the hand wheel to withdraw the rod 14 and the mandrel.

A tube bent with a device such as described is not drawn by undue stretching but is rolled out and the rolling contact followed by the part spherical disks finishes the inner wall of the tube with a smooth and uniform surface, and a perfect bend is produced with a single handling thereby effecting a very great saving both in time and in materials.

What I claim as my invention is:—

1. In an apparatus for bending tubes, a forming block, a mandrel having a tapered end and a recess in one side thereof, a swaging roller rotatably arranged in said recess, said roller conforming to the transverse peripheral shape of the mandrel and presenting an arc-shaped surface adapted to engage the major portion of the inner wall of the half of the tube farthest from the forming block and which is to be swaged, means for swinging said mandrel around the forming block, and a swaging member carried by said mandrel supporting means and adapted to engage the outer side of the tube.

2. In an apparatus for bending tubes, a forming block, a mandrel having a tapered end and formed with a cupped recess in one side thereof at the tapered end, a roller held within said cupped recess having its axis arranged in transverse relation to the axis of the mandrel, the longitudinal peripheral shape of said roller conforming to the circle shape of the inner wall of the tube and adapted to engage the major portion of the half of the tube farthest from the forming block, means for supporting said mandrel adapted to swing around the forming block, an arm pivotally supported from the mandrel supporting means, a swaging roller journaled on said arm and having a grooved periphery adapted to fit the external surface of the tube to be bent, and means adapted to engage said arm to swing said swaging roller into contact with the tube to be bent.

3. In an apparatus for bending tubes, a grooved forming block about which the tube is to be bent, a member rotatably supported to swing about the center of said forming block, a mandrel carried on said rotatable

member and having a tapered end, said mandrel having a recess formed in the side farthest removed from the forming block, said recess being of concave shape both transversely and longitudinally of the mandrel and cutting the periphery of the mandrel for the major portion of half of its transverse circumference, a roller tapered from the center to the ends in a curved shape, said curve conforming to the arc of the circle of said mandrel and said roller being adapted to fit snugly into the concaved recess in said mandrel, and arranged with its axis in radial alinement with the axis of the forming block and presenting a rolling contact for the major portion of the outer half of the mandrel engaging the inner wall of the outer half of the tube which is to be stretched and effecting a swaging of the metal of the tube, and a swaging roller mounted upon said rotatable member and held against the outer side of said tube with its axis in radial alinement with the axis of the forming block and mandrel roller.

4. In an apparatus for bending tubes, a concave forming block about which the tube is to be bent, a mandrel adapted to be inserted into the tube and having the end thereof tapered in an arc shape conforming to the arc of the circle of the bend of the inner wall of the outer half of the tube, said arc commencing in radial alinement with the center of the forming block about which the mandrel is swung, said mandrel having a recess cut in the outer side farthest from the mandrel, said recess being of circular shape in longitudinal section of the mandrel and of a double arc shape in transverse section of the mandrel, the radius of the arc conforming to the radius of the transverse section of the mandrel, said recess opening through the side of the mandrel in radial alinement with the center of the forming block and at the point of commencement of the arc of the taper of the end of the mandrel, a roller of double arc shape longitudinally adapted to fit snugly within the doubled arc-shaped recess and shaped to conform to the circle of the mandrel and presenting a rolling surface in the opening in the side of the mandrel to engage the inner wall of the major portion of the outer half of the tube to be bent, and a swaging roller held in engagement with the outer side of the outer half of the tube and arranged in radial alinement with the mandrel roller.

5. In an apparatus for bending tubes, in combination a forming block, a mandrel having a rolling contact surface adapted to engage the major portion of the outer half of the inner wall of the tube to be bent, a swaging member held in definite relationship to said mandrel and adapted to engage the outer periphery of the tube to be bent in radial alinement with the axis of the forming block and the engaging peripheral surface of the rolling contact of the mandrel, and a flexible follower comprising a plurality of links and disks formed with part spherical peripheral faces.

Signed at the city of Toronto, Ontario, Canada, this 9th day of April 1913.

JOHANNES RUCKSTINAT.

Witnesses:
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H. L. TRIMBLE.

Copies of this patent may be obtained for five cents each, by addressing the "Commissioner of Patents, Washington, D. C."