W. H. BURT.

TUBE BENDING MACHINE.

APPLICATION FILED DEC. 29, 1917.

1,267,845.

Patented May 28, 1918.

4 SHEETS—SHEET 1.

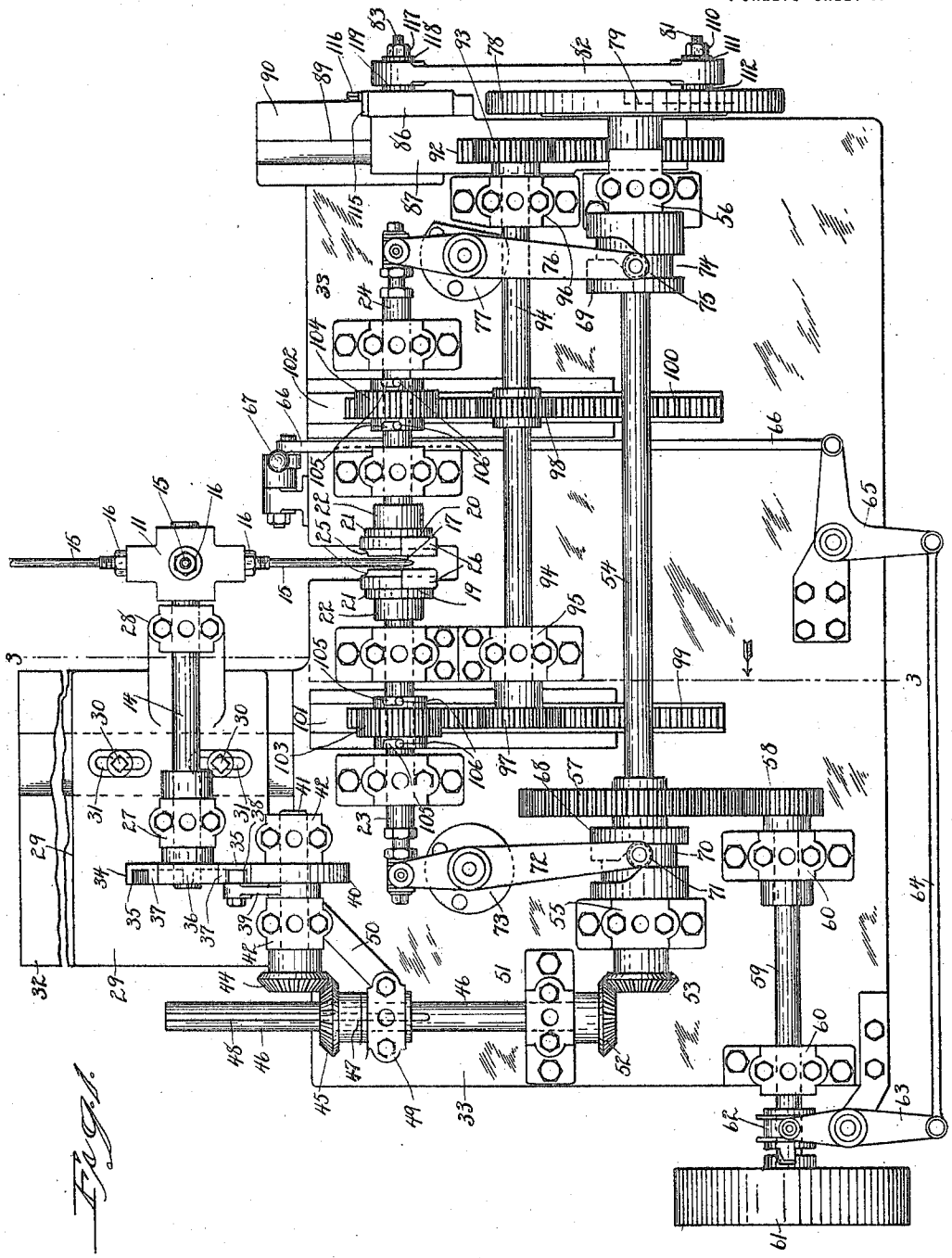

Fig. 1.

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by Seymour & Earle
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Fig. 3.

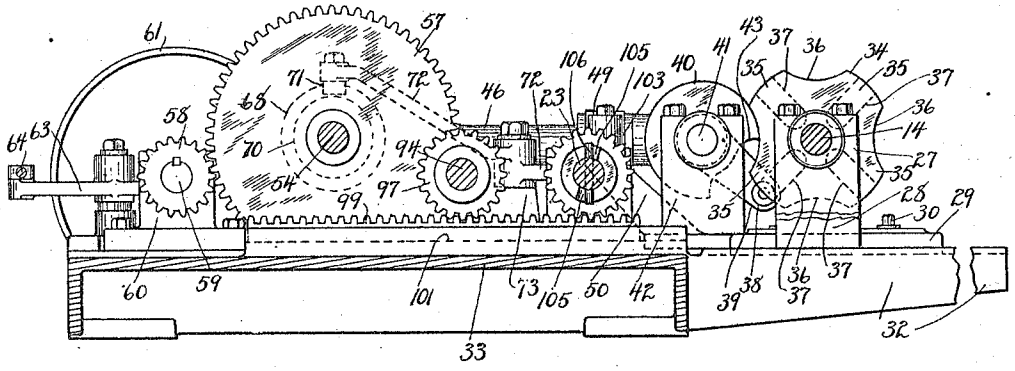

Fig. 4.

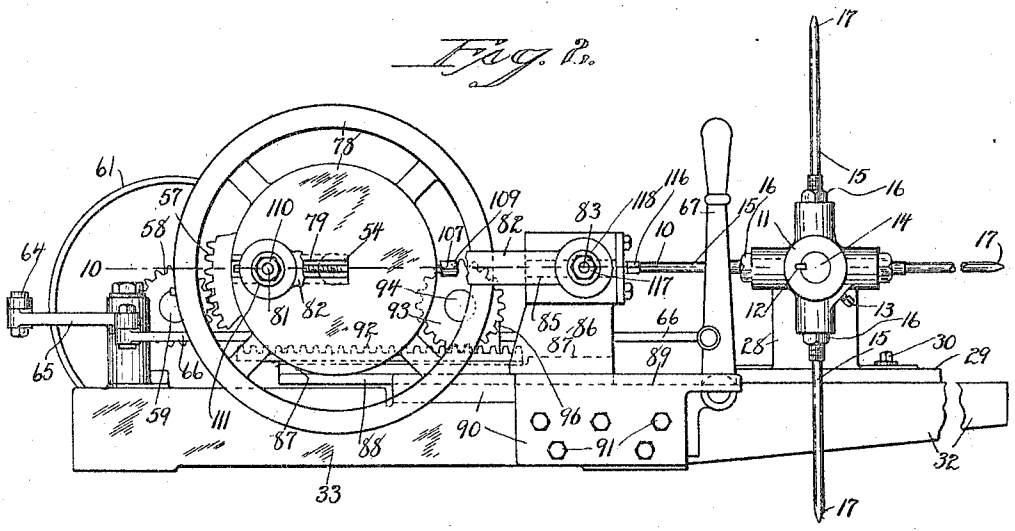

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Fig. 5.

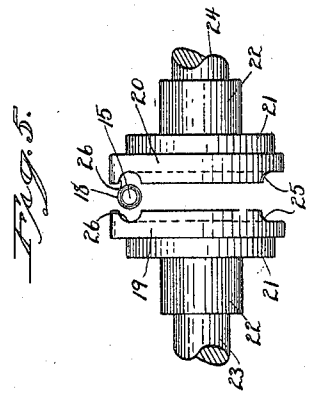
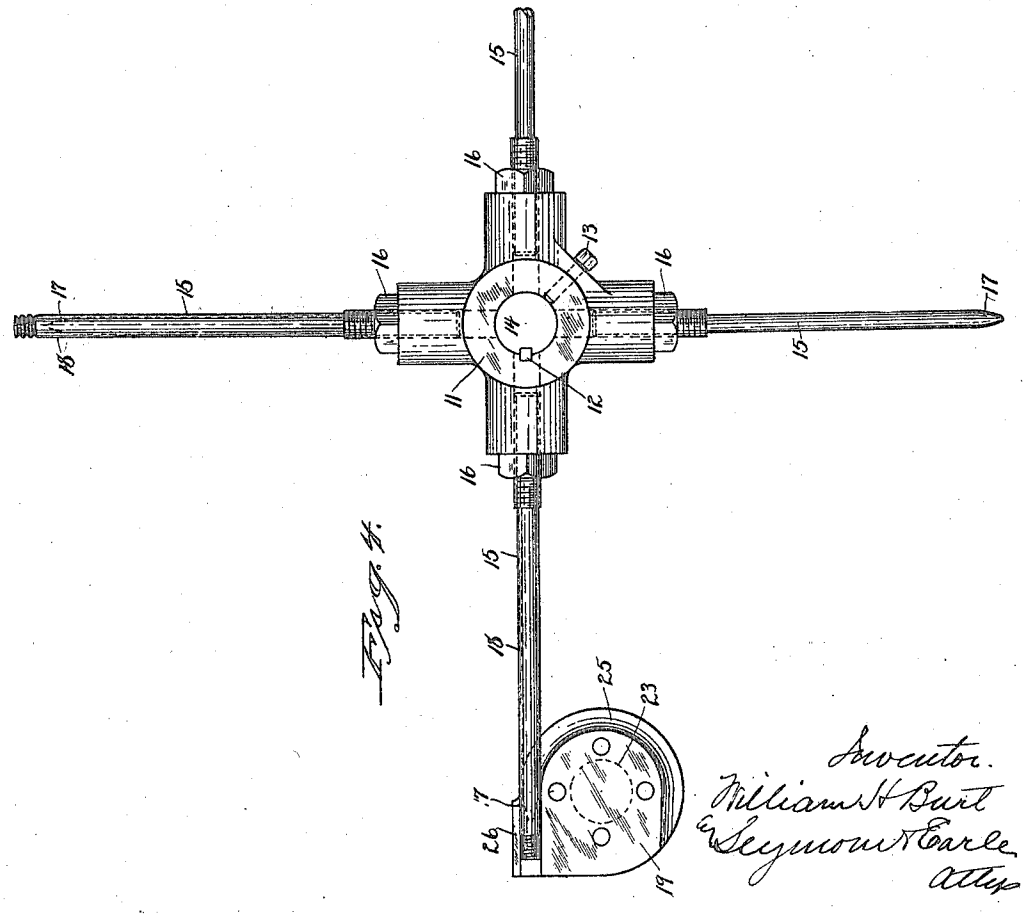


Fig. 4.



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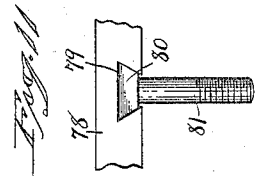


Fig. 11.

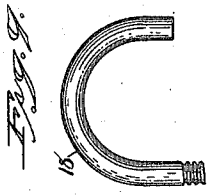


Fig. 7.

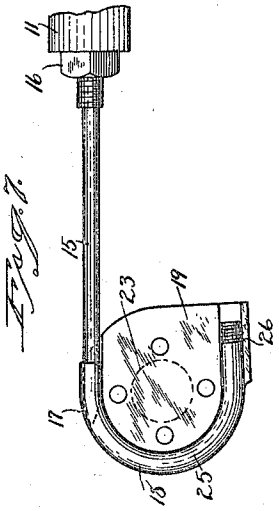
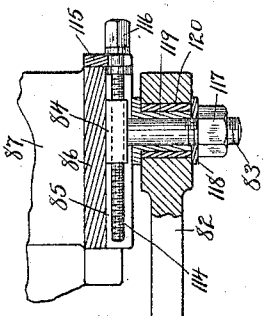


Fig. 7.



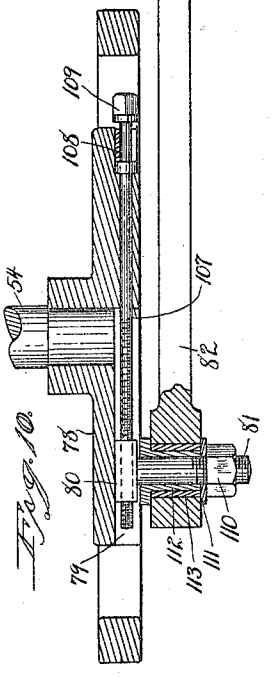


Fig. 10.

Fig. 8.

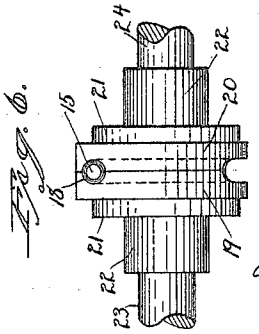


Fig. 9.

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UNITED STATES PATENT OFFICE.

WILLIAM H. BURT, OF WATERBURY, CONNECTICUT, ASSIGNOR TO WATERBURY MFG. CO., OF WATERBURY, CONNECTICUT, A CORPORATION.

TUBE-BENDING MACHINE.

1,267,845. Specification of Letters Patent. Patented May 28, 1918.

Application filed December 29, 1917. Serial No. 209,407.

To all whom it may concern:

Be it known that I, WILLIAM H. BURT, a citizen of the United States, residing at Waterbury, in the county of New Haven and State of Connecticut, have invented a new and useful Improvement in Tube-Bending Machines; and I do hereby declare the following, when taken in connection with the accompanying drawings and the characters of reference marked thereon, to be a full, clear, and exact description of the same, and which said drawings constitute part of this application, and represent, in—

Figure 1 a plan view of a tube-bending machine constructed in accordance with my invention.

Fig. 2 a view thereof in right hand side elevation.

Fig. 3 a view thereof in transverse section on the line 3—3 of Fig. 1.

Fig. 4 a detached view in elevation of the mandrel-carrier and mandrels shown in conjunction with one of the two complementary bending-heads, the said parts being shown in the positions they occupy just before the closing of the bending-heads for gripping the outer end of a tube preparatory to bending it.

Fig. 5 a view in front elevation showing the two bending-heads in their open positions with a tube and mandrel introduced between them for the gripping of the tube.

Fig. 6 a corresponding view after the heads have been closed for gripping the tube.

Fig. 7 a broken view corresponding to Fig. 4, but showing the bending-heads after they have been oscillated for bending the tube.

Fig. 8 a detached view of a tube such as my machine is adapted to bend.

Fig. 9 a view showing the tube as bent.

Fig. 10 a broken sectional view on the line 10—10 of Fig. 2, showing the means for regulating the length of oscillatory movement of the bending-heads, and for locating the point at which the tube is gripped with respect to the ends of the mandrels.

Fig. 11 a detached view in elevation of the crank-pin and its beveled base, shown as located in the undercut groove of the crank-wheel.

My invention relates to an improved machine for bending tubes and particularly the short lengths of tubing used in the manufacture of gas fixtures, though not so limited, the object of my invention being to produce a simple and efficient automatic machine of the character described.

With these ends in view, my invention consists in a tube-bending machine having certain details of construction and combinations of parts as will be hereinafter described and pointed out in the claims.

In carrying out my invention, as herein shown, I employ a four-armed mandrel-carrier 11 secured by a key 12 and set-screw 13 to a shaft 14 of intermittent rotary movement. Each arm of the said carrier is axially threaded for the reception of the threaded inner end of a mandrel 15 prevented from unscrewing by a lock-nut 16. The outer ends of the mandrels are tapered as at 17. Tubes 18 having, as shown, their outer ends threaded and a little longer than the mandrels 15, are manually fed to the upstanding mandrel as shown in Fig. 4. Thereafter the action of the machine is purely automatic.

The tubes are bent while being stripped off the mandrels, by means of two complementary, disk-shaped bending-heads 19 and 20 respectively fastened to disks 21 at the inner ends of hubs 22 secured to alined, but independent, reciprocating and oscillatory shafts 23 and 24. The opposing faces of the said gripping-heads are formed with grooves 25 which substantially correspond in form to the outline of the tube to be bent, these grooves being quarter-grooves in cross-section, as clearly shown in Figs. 4 and 5, except at their inner ends which are extended in a straight line into the opposing faces of gripping-offsets 26 formed upon the heads, the grooves being semi-circular in cross-section in these offsets, as clearly shown in Fig. 5.

The tubes, whatever their character, are manually fed to the mandrels 15 and by the same automatically introduced and positioned between the gripping-offsets 26 of the bending-heads which are separated or opened for the purpose, as shown in Fig. 5. A tube having been properly presented, as described, the heads are closed together as shown in Fig. 6, whereby the outer end of the tube is firmly gripped by the bending-heads which are now oscillated together, with the effect of stripping the tube off the

mandrel as shown by Fig. 7. The heads are now separated, whereby the bent-tube is released, and reversely turned back into their initial or tube-gripping positions. The mandrel-carrier has meanwhile been given another quarter turn, and another tube on the succeeding mandrel been positioned between the now separated bending-heads for the repetition of the operation.

The means employed for imparting step-by-step rotation to the mandrel-carrier and for opening and closing and oscillating the bending-heads, may assume a variety of forms within the purview of my invention, which is not confined to any particular means to effect these movements.

For the purpose, however, of illustrating a complete machine for carrying out my invention, I have shown, and will now describe, means for operating the mandrel-carrier and the bending heads as required.

The mandrel-shaft 14 aforesaid, is journaled in bearings 27 and 28 (Fig. 1) upstanding from a carriage 29 adjustably secured by bolts 30 extending through slots 31, to a horizontal arm 32 offsetting from the machine-frame 33. By so adjustably mounting the carriage 29 upon the arm 32, I am enabled to move the mandrel-carrier toward and away from the bending-heads 19 and 20 so as to provide for the use of mandrels varying in length, as may be required for different lengths of tubes.

At its inner end, the mandrel-shaft 14 is provided with a driving-head 34 having four equidistant arms 35, separated by as many curved locking-faces 36 and each containing a radial driving-groove 37 as shown in Fig. 3. The outer ends of said driving-grooves 37, successively receive an anti-friction roller 38 upon the outer end of a driving-arm 39 formed integral with a locking-disk 40 mounted upon a shaft 41 journaled in bearings 42 projecting upward from the inner end of the carriage 29 aforesaid. The said locking-disk 40 is formed in its periphery with a clearance-notch 43 adapted in length to receive and give clearance to, the arms 35 of the driving-head 34 and permit the same to be rotated for a quarter turn by the entrance of the roller 38 of the arm 39 into the outer end of the driving-groove 37 of one of its arms 35. After the head 34 has thus been rotated, the periphery of the locking-disk 40 enters one of the curved locking-faces 36, and thereafter locks the head 34 against rotation, until the roller 38 enters the groove 37 in the next arm 35 for the next quarter-turn of the head 34, and hence of the mandrel-carrier 11. The mechanism just described is well known for the purpose of imparting intermittent motion. The shaft 41 aforesaid, carries at its outer end a bevel gear 44 meshing into a bevel gear 45 feathered upon a shaft 46 by means of a key 47 and key-way 48, the said shaft being journaled at its adjacent end in a bearing 49 in an arm 50 upstanding from the carriage 29, so that when the same is adjusted as provided for, the gears 44 and 45 move with it undisturbed, the gear 45 sliding on the shaft 46, the opposite end of which is journaled in a bearing 51 secured to the machine-frame 33. The inner end of the said shaft 46, mounts a bevel gear 52 meshing into a bevel gear 53 upon the inner end of the main shaft 54 which is journaled in bearings 55 and 56 bolted to the machine-frame 33, the said main shaft 54 mounting a gear wheel 57 meshing into a driving pinion 58 on the inner end of a driving shaft 59 journaled in bearings 60 and having a driving pulley 61 loosely mounted upon its outer end, the said pulley being coupled and uncoupled from the shaft by means of a clutch 62 operated by a lever 63 connected by a rod 64 with a bell-crank lever 65 connected by a rod 66 with the controller-handle 67 by means of which the machine is stopped and started.

For the opening and closing movements of the bending-heads 19 and 20, the alined shafts 23 and 24 must be simultaneously moved toward and away from each other. For this purpose, the main shaft 54 is provided with two complementary cams 68 and 69. The cam 68 has a cam-groove 70 receiving a roller 71 upon the adjacent end of a lever 72 mounted upon a bracket 73 and having its opposite end suitably connected with the outer end of the shaft 23 for the reciprocation thereof. In the same manner the cam 69 is formed with a cam-groove 74 receiving a roller 75 upon the adjacent end of a lever 76 mounted upon a bracket 77 and having its opposite end suitably connected with the outer end of the shaft 24 for the reciprocation thereof in unison with the reciprocation of the shaft 23.

For the concurrent oscillatory movement of the bending-heads 19 and 20, the outer end of the main shaft 54 is provided with a crank-wheel 78 formed in its outer face with a radial undercut groove 79 receiving the beveled base 80 of a crank-pin 81 passing through one end of a crank or pitman 82 the opposite end of which receives a stud 83 having a beveled base 84 which is located in an undercut horizontal groove 85 in the upstanding arm 86 of a slide 87 formed upon its lower face with a guide-rib 88 entering a guide-way 88 in the upper face of a bracket 90 secured to the machine-frame 33 by bolts 91. The rotation of the crank-wheel 78 thus imparts reciprocatory movement to the slide 87 which carries a rack 92 meshing into a pinion 93 mounted upon the adjacent end of a rock-shaft 94 journaled in bearings 95 and 96 bolted to the frame 33 and rocked by the said rack 92 and pinion

93. The said rock-shaft 94 is furnished with pinions 97 and 98 respectively meshing into racks 99 and 100 thus reciprocated in grooves 101 and 102 in the frame 33. The rack 99 in turn meshes into a pinion 103 mounted upon the shaft 23 for the oscillation thereof. In the same manner, the rack 100 meshes into a pinion 104 mounted upon the shaft 24 for the oscillation thereof. For the connection of the pinions 103 and 104 with the shafts 23 and 24, respectively, the hubs of the pinions are formed with wide diametric notches 105 receiving coupling-pins 106 for which the notches provide some sidewise play, whereby the racks are allowed to get under way before starting to move the pinions 103 and 104, and hence the shafts 23 and 24.

For the purpose of lengthening or shortening the arc of oscillation of the bending-heads 19 and 20, as may be required to adapt the machine to bend tubes of varying lengths I employ a regulating screw 107 threaded through the base 80 of the crank-pin 81, the headed end of the screw being mounted in a bushing 108 set into the crank-wheel 78 and holding the screw against endwise movement. A head 109, at the extreme end of the screw provides for turning it. The crank-pin 81 is locked in place by a nut 110 bearing upon a washer 111 resting upon the outer end of a flanged bushing 112 the flange of which bears upon the outer face of the wheel 78, the bushing 112 being encircled by a bronze anti-friction sleeve 113. After positioning the crank-pin 81 by means of the adjusting screw 107, the nut 110 is screwed home, whereby the beveled base 80 is drawn outward and so caused to bind in the undercut groove 79 in the wheel 78.

For the purpose of adjusting the bending-heads 19 and 20 so that the half-round inner ends of their grooves will be in line with the mandrels when the same are introduced and positioned between the heads, I provide for adjusting the stud 83 with respect to the slide 87. For this purpose, I employ an adjusting screw 114 (Fig. 10), which is threaded through the beveled base 84 at the inner end of the stud 83, this screw being mounted in a plate 115 secured to the slide 87 and furnished with a head 116 by means of which it is turned. The stud 83 is locked in place when once adjusted, by means of a nut 117, a washer 118, and a flanged bushing 119, the latter being encircled by an anti-friction sleeve 120 in the manner already described for the crank-pin 81. The screw 114 provides, as it were, for swinging the arc in which the bending-heads oscillate, without changing its length which is provided for by the screw 107. The screw 114 thus locates the point at which the tubes are gripped with reference to the end of the mandrels.

The machine having been adjusted, and, as it were, timed, by means of the instrumentalities described, the tubes to be bent are fed by hand to the upstanding mandrel of the mandrel-carrier by which they are successively introduced automatically between the gripping-offsets of the bending-heads 19 and 20 which are separated at the time. The heads then close to grip the outer end of the tube, and are so oscillated from the position in which they are shown in Fig. 4 into the position in which they are shown in Fig. 7. They now open and release the bent tube, and the mandrel-carrier makes a quarter turn for the discharge thereof and the presentation of another tube between the bending-heads, meanwhile returned by reverse oscillatory movement to their starting positions, and so on. It is apparent, of course, that the numebr of mandrels carried by the mandrel-carrier may be varied as desired.

I claim:—

1. A tube-bending machine having two bending-heads, automatic means for moving both of the said heads toward and away from each other, means for turning them simultaneously when in their closed positions, a mandrel-carrier supporting a mandrel, and means for automatically operating the said mandrel-carrier intermittently, whereby one end of the tube to be bent is positioned and held at rest between the said heads when the same are in their open positions, after which the heads are closed upon the tube which is then bent by the rotation of the heads which then separate to release the bent tube and permit the mandrel-carrier to move to present another tube.

2. A tube-bending machine having two bending-heads, automatic means for moving both of the said heads toward and away from each other, means for rotating the same simultaneously when in their closed positions, a mandrel-carrier carrying a plurality of mandrels, and means for automatically operating the said carrier step-by-step, whereby the tubes to be bent are successively positioned between the heads when the same are in their open positions, after which the heads are closed upon the tube while the mandrel-carrier is at rest, after which the heads are turned for stripping the tube from the mandrel in position between the heads.

3. A tube-bending machine having two bending-heads formed with tube-gripping offsets and with opposed complementary tube-receiving grooves which extend into the said offsets, automatic means for moving both of the said heads toward and away from each other, means for simultaneously turning them when they are in their closed positions, and intermittently operated automatic tube-feeding means for presenting

tubes to the said heads when the same are in their open positions and remaining at rest when the same are in their closed positions.

4. A tube-bending machine having two complementary bending-heads adapted to grip a tube and to bend the same into curved form, means for moving the said heads toward and away from each other and for turning them when in their closed positions, and means for automatically presenting the outer end of a tube-carrying mandrel between them.

5. A machine for bending tubes having two bending-heads adapted to grip a tube by one of its ends and to bend the tube into curved form, means for moving the said heads toward and away from each other and for turning them, a mandrel-carrier for presenting the tubes to the said heads, and means for the step-by-step rotation of the mandrel carrier.

6. A tube-bending machine having bending-heads the opposing faces of which are formed with grooves and which are provided with tube-gripping offsets into which the said grooves are extended in semi-circular form, means for moving said heads toward and away from each other in line, and for turning them, and a mandrel-carrier rotated step-by-step to automatically introduce the outer ends of tubes between the said heads when the same are in their open positions.

7. A tube-bending machine having complementary bending-heads for gripping the outer end of a tube and bending the tube into curved form, means for moving the said heads into their open and closed positions and for turning them, means for automatically presenting a tube to the said heads, and means for regulating the turning movement of the heads.

8. A tube-bending machine having complementary bending-heads for gripping the outer end of a tube and bending the tube into curved form, means for moving the said heads into their open and closed positions and for turning them, a mandrel for presenting a tube to the heads, and means for regulating the position of the arc in which the heads turn, with respect to the end of the mandrel when the same is in its tube-delivering position.

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

WILLIAM H. BURT.

Witnesses:
H. C. RECKER,
J. S. NEAGLE.