March 8, 1932. E. T. SPATE ET AL 1,848,753

TUBE BENDING MACHINE

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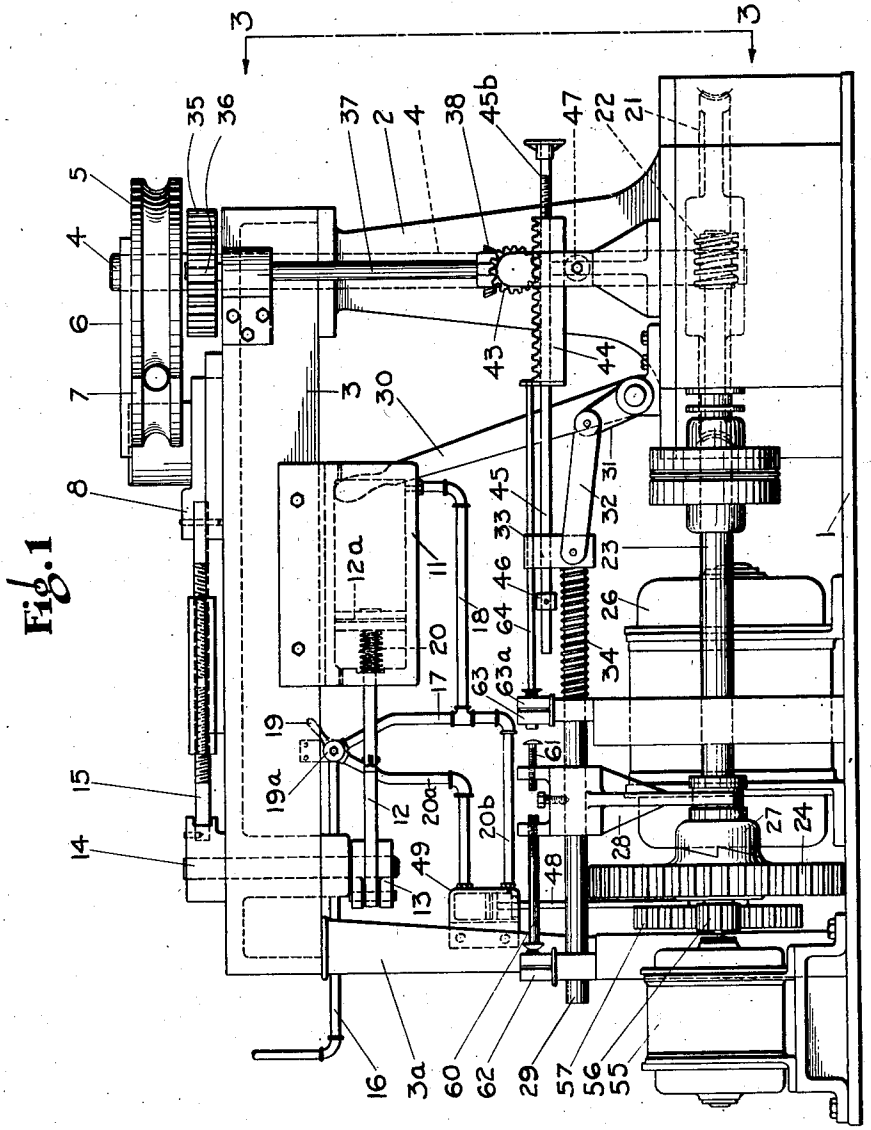


Fig. 1

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Fig. 3

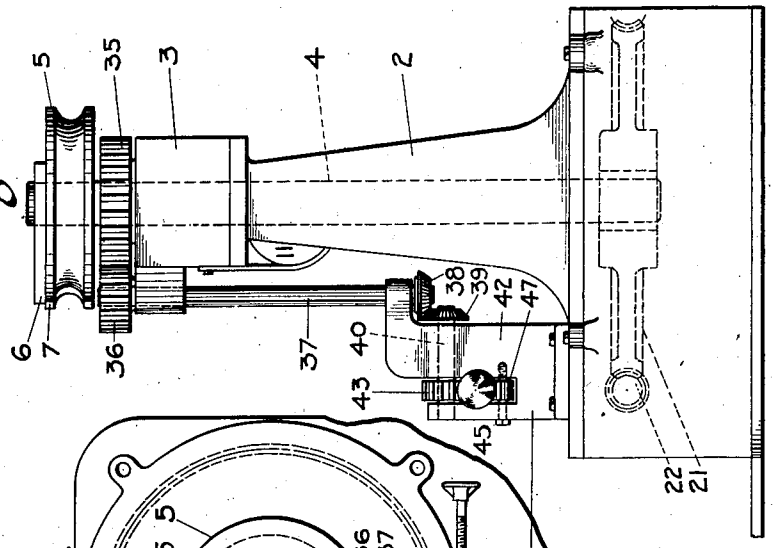
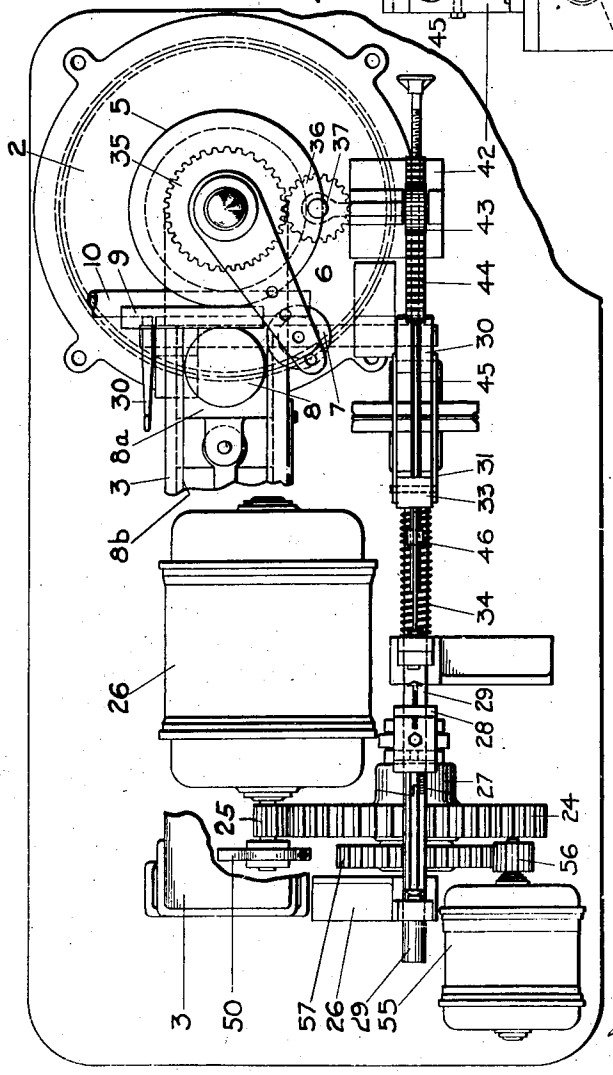


Fig. 2



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TUBE BENDING MACHINE

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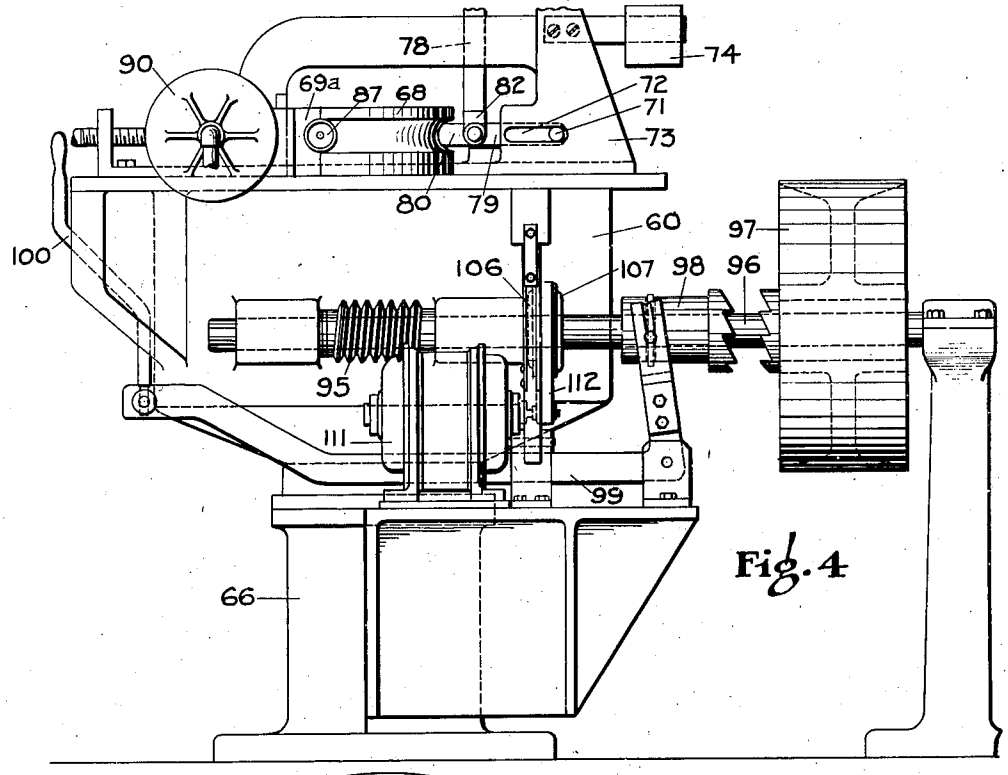


Fig. 4

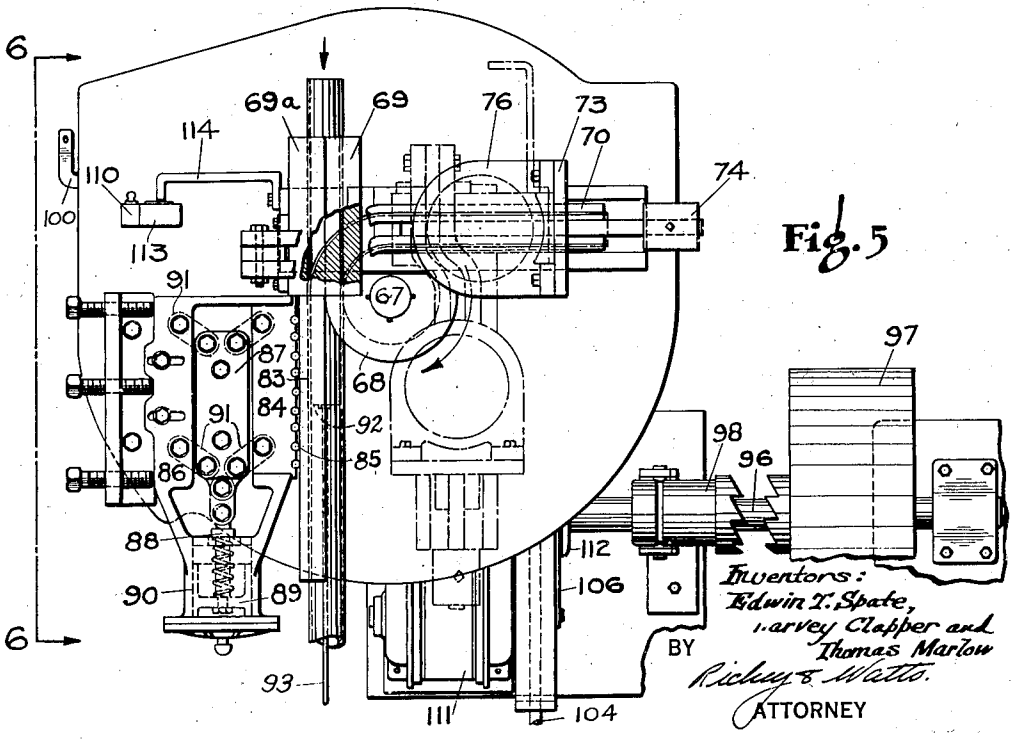


Fig. 5

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TUBE BENDING MACHINE

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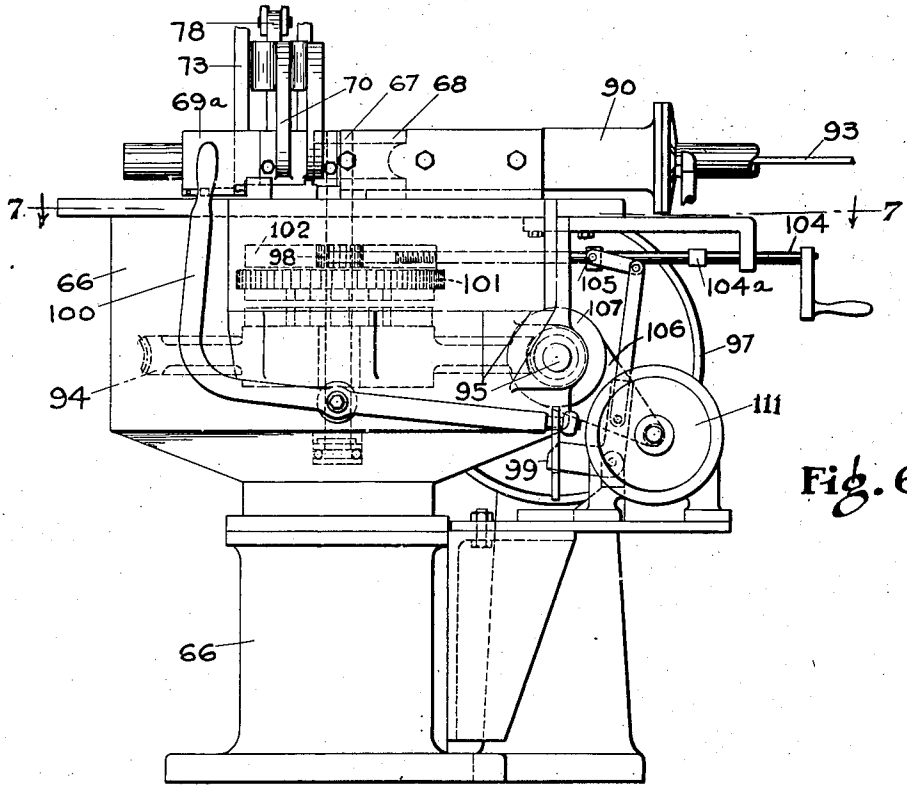


Fig. 6

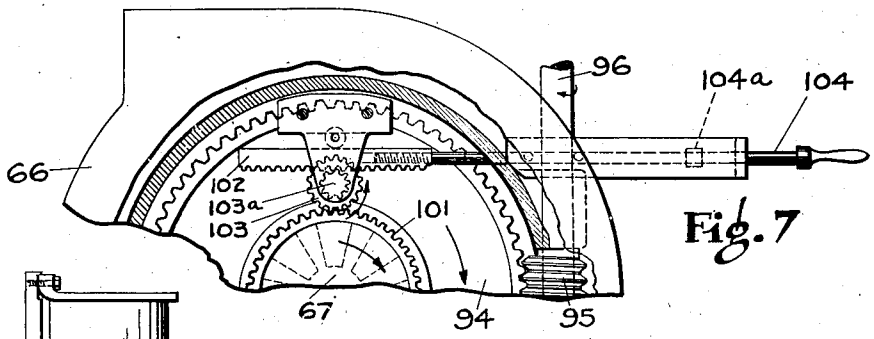


Fig. 7

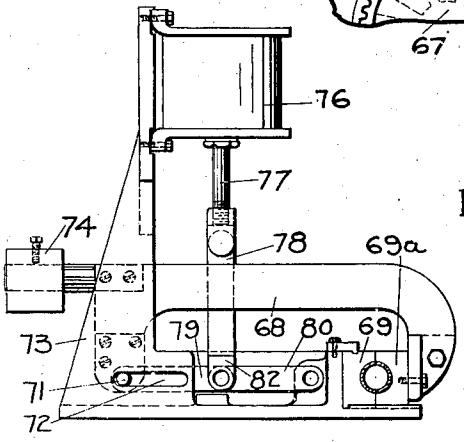


Fig. 8

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Patented Mar. 8, 1932 1,848,753

UNITED STATES PATENT OFFICE

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TUBE BENDING MACHINE

Application filed January 2, 1930. Serial No. 417,919½.

This invention relates to bending machines, and more particularly to new and improved tube bending machines.

Power actuated machines have been utilized for bending metal tubes longitudinally into curvilinear form. Such machines have not been constructed so as to operate through their cycle without requiring considerable attention by the operator. They have required that the operator actuate a plurality of levers at proper times, and even then the operation of the machine is somewhat jerky and imposes undue strains on the parts of the machine.

It is accordingly an object of this invention to provide tube bending machines provided with improved mechanism for controlling the various movements thereof; to provide smoothly operating machines; to provide such machines with much simplified mechanism for controlling and producing more or less automatic actuation while eliminating many of the strains heretofore present in bending machines when in use; and to greatly lessen the manual labor heretofore required in bending tubing by machines.

Other objects will be apparent from the specification and from the accompanying drawings in which

Figure 1 is a side elevation of one form of bending machine embodying our invention;

Figure 2 is a top plan view of the device of Figure 1 with certain parts broken away;

Figure 3 is an end elevation of the construction of Figures 1 and 2, as indicated by the lines 3—3, Fig. 1.

Figure 4 is a fragmentary side elevation of a machine embodying our invention;

Figure 5 is a top plan view of the device of Figure 4 with parts broken away and showing, in dotted lines, an actuated position of certain parts;

Figure 6 is an end elevation as viewed from line 6—6 of Figure 5;

Figure 7 is a horizontal sectional view taken along the line 7—7 of Figure 6; and

Fig. 8 is a side elevation of the clamping device shown fragmentarily in Fig. 4.

Referring first to Figures 1, 2 and 3 of the drawings, the bending machine there shown comprises a bed plate 1 which supports a pedestal 2. An elongated table 3 projects laterally from the pedestal and at its opposite end is supported by leg 3*a*. A vertically disposed bending roll shaft 4 is mounted for rotation in the pedestal 2 and is keyed to a bending roll assembly comprising the circumferentially grooved bending roll 5, bracket 6 and the circumferentially grooved clamping roll 7 which latter cooperates with the bending roll during rotation thereof to secure the end of the pipe to be bent. A clamping jaw 8 in the form of a rotatable roll is mounted on a slide 8*a* for longitudinal reciprocatory movement in a slideway 8*b* on the table 3 and is adapted to press a longitudinally grooved follower shoe 9 against the bending roll to support the pipe 10 therebetween at the area being bent and prevent wrinkling of the metal of the pipe. Actuation of the clamping jaw 8 is effected by means of a fluid pressure cylinder 11, piston 12*a* therein, rod 12 connected to the piston and to link 13 which in turn is keyed to shaft 14, the latter being connected to a rod 15 attached to slide 8*a*. Fluid under pressure is admitted to the cylinder through pipes 16, 17 and 18 and is controlled by a valve 19*a* having a handle 19. A spring 20 returns piston 12*a* to its original position when the fluid pressure in cylinder 11 is released. Conduit 20*a* joins valve 19*a* to cylinder 49. Line 20*b* leads from pipe 18 to cylinder 49 below the piston therein.

Rotation of the bending roll shaft 4 is effected through the worm wheel 21 keyed to the lower end of the shaft which wheel engages with the worm 22 of the worm shaft 23. Worm shaft 23 is driven by the gear 24 which meshes with a gear 25 which latter is driven by the motor 26. The gear 24 is mounted for rotation with respect to the shaft 23 but drives shaft 23 through a clutch member 27 which is mounted on shaft 23 for longitudinal movement with respect thereto. The clutch member 27 is actuated by means of a clutch yoke 28 carried by a rod 29 which in turn is movable axially by a manually operated lever 30 acting through the links 31 and 32 which latter is attached to block 33 on rod 29. A spring 34 assists in returning the

rod 29 and clutch member 27 to a clutch disengaging position.

The bending roll shaft 4 carries keyed thereto a gear 35 which meshes with a gear 36 keyed to a vertical shaft 37. Shaft 37 carries a bevel gear 38 at its lower end which meshes with a bevel gear 39 on horizontal shaft 40. Shaft 40 has keyed thereto a gear 43 which meshes with a horizontally movable rack 44 through which extends a rod 45 adjustable in the rack 44 by screw 45*b*. Rod 45 carries a stop 46, and an antifriction roll 47 which supports the rack 44.

A connecting rod 48 fastened to a piston in fluid pressure cylinder 49 actuates a brake 50 against and away from a brake drum carried by the shaft of motor 26.

Motor 55 rotatable in the direction opposite to that of motor 26 carries a pinion gear 56 to mesh with gear 57 keyed to the main machine drive shaft 23.

The clutch yoke 28 carries adjustable rods 60 and 61. The former is adjusted to close a switch 62 when the clutch 27 is engaged with gear 24. Rod 61 is adjusted to close switch 63 when clutch 27 is out of engagement with gear 24. A rod 64 carried by rack 44 and slidable in block 33 is adjustable to close auxiliary switch 63*a* as soon as rack 44 starts to move to the right in Figure 1.

Switch 62 is in the power line (not shown) which energizes motor 26. When rod 60 releases this switch the power line to motor 26 is broken automatically. Switch 63 is in the power line (not shown) which energizes motor 55 and completes the circuit through motor 55 when rod 61 closes the contacts. Switch 63*a* is also in the power line of motor 55 and is opened when rod 64 engages it.

The operation of the device of Figures 1, 2 and 3 is as follows:

A piece of tubing 10 is inserted between rolls 5 and 7, the follower shoe 9 is placed against the tube. Valve handle 19 is moved to admit fluid under pressure into cylinder 11, and into cylinder 49 through pipe 20*b*. Piston 12*a* is moved against spring 20 and clamps roll 8 against shoe 9. The brake rod 48 is lifted to free the brake from the drum of motor 26. Then lever 30 is moved from a substantially upright position to that shown in Figure 1 which meshes clutch 27 with gear 24 and closes switch 62. Motor 26 is thereby energized and rotates shaft 23, shaft 4 and roll 5. When roll 5 has rotated to the predetermined extent, the rack 44 has brought block 46 into engagement with block 33 and has moved the latter with lever 30 and rod 29 to the right in Figure 1 thereby opening switch 62 to de-energize motor 26, and disengage clutch 27. The motor 55 is rotated backwardly during the time clutch 27 is engaged with gear 24.

When clutch 27 is disengaged, valve handle 19 is turned to release the fluid pressure in cylinders 11 and 49 and to admit fluid under pressure through conduit 20*a* into cylinder 49 to apply the brake to motor 26 and stop the latter. Follower shoe 9 can then be readily removed.

When rod 61 closes switch 63 and energizes motor 55 the latter is then driven to rotate shaft 23 in the reverse direction and to return roll 5 and rack 44 to their initial positions, whereupon switch 63*a* is opened and motor 55 is de-energized.

The bent tube is then removed, another tube inserted as before, and the foregoing operations are repeated.

Referring now to the modification illustrated in Figs. 4, 5, 6, 7 and 8 the device comprises a pedestal 66 which carries a rotatable, vertically disposed bending roll shaft 67. A bending roll assembly securing the pipe to be bent during the bending operation, is rigidly affixed to the shaft 67 and comprises a bending roll 68, a clamping jaw 69 rigidly associated with the bending roll and a clamping jaw 69*a* movable with respect to the bending roll. The bending roll 68 is grooved circumferentially to receive the pipe and the clamping jaws 69 and 69*a* are grooved longitudinally for the same purpose.

The clamping jaw 69*a* is mounted in arm 70 for lateral and pivotal movement with respect to the clamping jaw 69. This arm 70 is carried by a pin 71 which is disposed for sliding movement in slots 72 in a bracket member 73 which latter is rigidly associated with the bending roll 68. A counterweight 74 is carried by the arm 70. The arm 70 is actuated by fluid pressure means including a cylinder 76 (see Fig. 8), a piston therein (not shown) piston rod 77, and link 78 which is pivotally attached to the piston rod 77 and to the links 79 and 80. Link 80 is pivotally attached to the fixed jaw 69 and link 79 is pivotally secured to the pins 71. Upward movement of the piston rod 77 draws the connected ends of links 79 and 80 upwardly thereby drawing pins 71 toward clamp 69 and moving the arm 70 outwardly and carrying the clamping jaw 69*a* away from jaw 69 to release a pipe clamped therebetween. Further upward movement of the piston rod 77 causes the shouldered portion 82 (Fig. 4), of link 78 to engage with the arm 70 and elevate the same in pivotal movement about the pivot pins 71.

To prevent injury to the tube during bending, a follower shoe 83 is provided and is positioned by a clamping device which includes a member 84 carrying rollers 85 to engage the shoe 83, which member is laterally slidable in a frame 86 adjustably fixed to rod 60. This frame has a longitudinally movable member 87, which is attached to rod 88 for reciprocation by a piston 89 in cylinder 90. Toggle links 91 move member 84 lat-

erally in frame 86 when member 87 is reciprocated and in one position forces shoe 83 against the tube which is being bent. A mandrel 92 carried by the rod 93 and actuated by a fluid pressure cylinder and piston (not shown) is adapted to be inserted into the tube in the position shown in Figure 5 to support the walls thereof at the portion being bent to prevent wrinkling thereof.

The bending roll shaft 67 carries keyed thereto a worm gear 94 which is adapted to engage with a worm 95 upon the main drive shaft 96. Rotation of the shaft 96 is effected through a pulley wheel 97 loosely mounted upon the shaft 96 but engageable with a clutch member 98 keyed to the shaft 96 for longitudinal movement thereon. The clutch 98 is movable by means of a pivoted lever 99 which can be actuated by a hand lever 100 pivoted to the pedestal.

A gear 101, (see Figs. 6 and 7) keyed to the shaft 67 operates a rack 102 longitudinally by means of gears 103 and 103*a* which mesh respectively with gear 101 and rack 102. Rack 102 carries an adjustable rod 104 which carries a stop 104*a*. At one end of the stroke of the rack 102 the block 104*a* engages a block 105 attached to one arm of a bell crank 106, the other arm of which rests on lever 99.

A switch 110 is manually closed to energize the motor 111 which has a driving connection 112 with shaft 96 to rotate shaft 96 in the reverse direction. Switch 113 in the power line of motor 111 is opened to de-energize motor 111 when arm 114 engages therewith upon completion of the reverse movement of shaft 67.

The operation of the device is as follows:

A tube is placed in die 69 and die 69*a* is clamped against it by admission of fluid under pressure into cylinder 76. The mandrel is forced into the tube by fluid pressure. The shoe 83 is placed against the tube and member 84 is pressed thereagainst by means of fluid pressure in cylinder 90. Then lever 100 is pulled down to engage clutch 98 with pulley 97 and switch on motor whereupon shaft 96 rotates and causes rotation of shaft 67 to bend the tube.

When shaft 67 has rotated the predetermined distance, block 104*a* moves bell crank lever 106 thereby depressing lever 99 and disengaging clutch 98 from pulley 97 and switching off motor.

Then clamp 69*a* and shoe 83 are released and the mandrel is withdrawn.

The tube is then removed after which switch 110 is closed to energize motor 111 and return the parts to their starting position.

While preferred embodiments of our invention have been shown and described it will be understood that various modifications can be made therein within the scope of the appended claims.

We claim:

1. In a bending machine, a bending roll assembly, driving means, means for operatively connecting the driving means and assembly, rotatable means associated with the assembly adapted to be rotated thereby, and means associated with the rotatable means adapted to be moved thereby into engagement with the connecting means to disengage the assembly and deactivate said driving means.

2. In a bending machine, a bending roll assembly, driving means, means for operatively connecting the driving means and assembly, rotatable means associated with the assembly adapted to be rotated thereby, and means associated with the rotatable means adapted to be moved thereby into engagement with the connecting means to disengage the assembly and driving means, means rotatable in opposite directions to return the assembly to its initial position, and a separate drive for said latter means.

3. In a bending machine, a bending roll assembly, driving means, means for operatively connecting the driving means and assembly, a second driving means adapted to drive the assembly in a direction reverse to that of the first mentioned driving means, and means associated with the assembly adapted to be actuated thereby into engagement with the connecting means to disengage the assembly from the first mentioned driving means and means to activate the second mention driving means.

4. In a bending machine, a bending roll assembly, driving means, means for operatively connecting the driving means and assembly, a second driving means adapted to operate the assembly in a direction reverse to that of the first mentioned driving means, rotatable means associated with the assembly adapted to be rotated thereby, means associated with the rotatable means adapted to be moved thereby out of engagement with the connecting means to discharge the assembly and first mentioned driving means and means to activate the second mentioned driving means after the first mentioned driving means is disengaged from the assembly.

5. In a bending machine, a bending roll assembly, driving means, means for operatively connecting the driving means and assembly, a second driving means adapted to operate the assembly in a direction reverse to that of the first mentioned driving means, rotatable means associated with the assembly adapted to be rotated thereby, and means associated with the rotatable means adapted to be moved thereby out of engagement with the connecting means to disengage the assembly and driving means, and separate means to activate the second mentioned driving means.

6. In a bending machine, a bending roll assembly, driving means, means for operatively connecting the driving means and assem-

bly, a second driving means adapted to operate the assembly in a direction reverse to that of the first mentioned driving means, and means associated with the assembly adapted to be actuated thereby out of engagement with the connecting means to disengage the assembly from the first mentioned driving means, means to activate the second mentioned driving means after the first said means is disconnected and means to deactivate the second mentioned driving means automatically.

7. In a bending machine, a bending roll assembly, means to drive the assembly, clutch means for operatively connecting the driving means and assembly, a second driving means connected to the bending roll assembly and adapted to operate in a direction reverse to that of the first mentioned driving means, means actuated by the roll assembly for effecting predetermined disengagement of the first mentioned driving means from the assembly, separate means for activating the second driving means, and means controlled by the position of the assembly for de-activating the second driving means at a predetermined position of the assembly.

8. In a tube bending machine, a bending roll assembly, an electric motor for driving said assembly, clutch mechanism for operatively connecting the drive of the motor with said assembly, reversing mechanism for said assembly, a separate electric motor for driving said reversing mechanism, and switch operating means associated with said clutch mechanism for alternately energizing and de-energizing said motors.

9. In a tube bending machine, a bending roll assembly including a bending roll, a shaft on which said roll is mounted, a motor for driving said shaft, clutch mechanism for operatively connecting the drive of the motor with said shaft, a switch, and means actuated through the rotation of said shaft for disengaging said clutch mechanism and throwing said switch.

10. In a tube bending machine, a bending assembly including a bending roll, a shaft on which said bending roll is mounted, a motor for driving said shaft in one direction to bend a tube, a separate motor for reversing the drive on said shaft, an electrical circuit for said motors, a switch in said circuit, clutch mechanism, and means having a geared connection with said shaft for actuating said clutch mechanism and also said switch means.

11. In a tube bending machine, a bending roll assembly including a bending roll, a shaft on which said roll is mounted, a motor for driving said shaft, clutch mechanism for operatively connecting the drive of said motor with said shaft, a switch for energizing and de-energizing said motor, a rack having a geared connection with said shaft, and means adapted to be actuated by said rack for actuating said clutch mechanism and throwing said switch.

12. In a tube bending machine, a bending roll, a shaft on which said roll is mounted, a motor for reversely driving said shaft, a switch for energizing and de-energizing said motor, clutch mechanism for operatively connecting the drive of said motor with said shaft, a lever for throwing said clutch mechanism, a rack having a geared connection with said shaft, a rod connected to said rack, and means on said rod for actuating said lever and throwing said switch.

In testimony whereof we hereunto affix our signatures this 12th day of November, 1929.

EDWIN T. SPATE.
HARVEY CLAPPER.
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