J. C. WILSON.

BENDING MACHINE.

APPLICATION FILED JAN. 29, 1909.

1,007,834.

Patented Nov. 7, 1911.

4 SHEETS—SHEET 1.

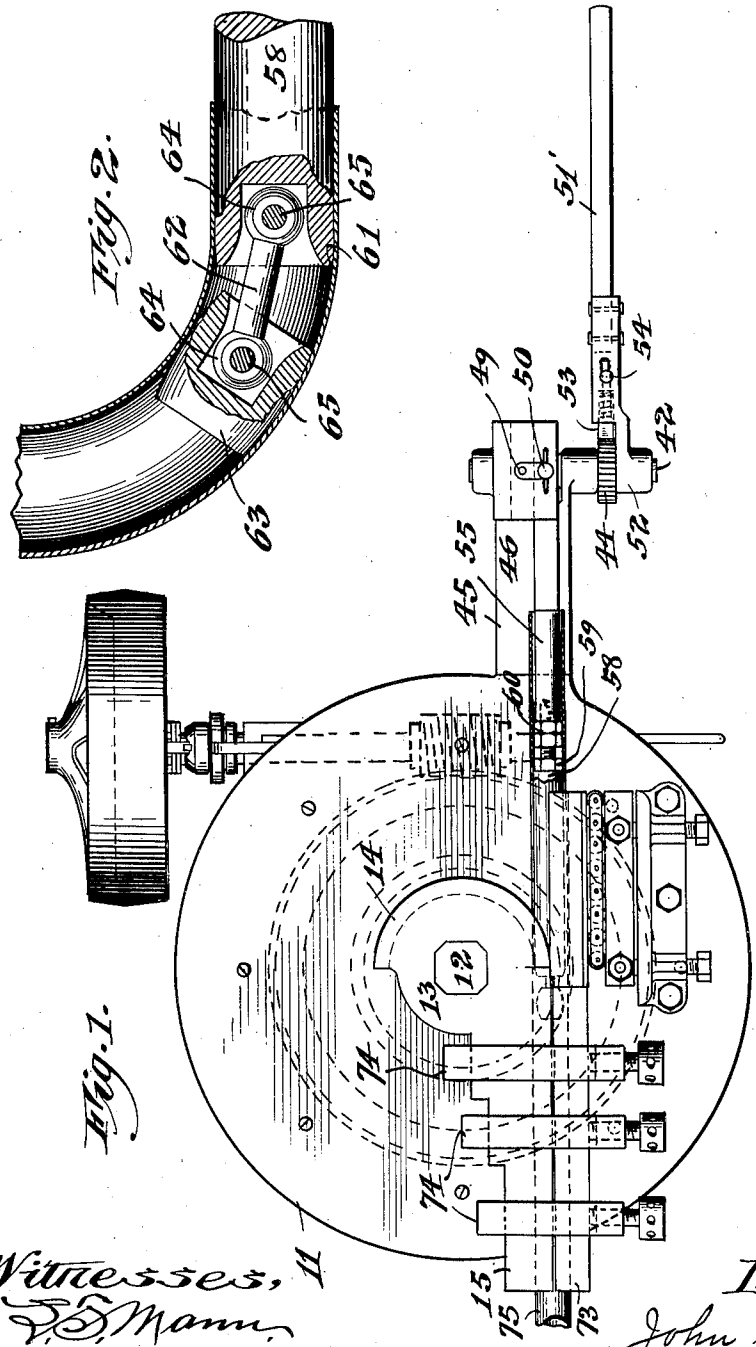

Fig. 2.

Fig. 1.

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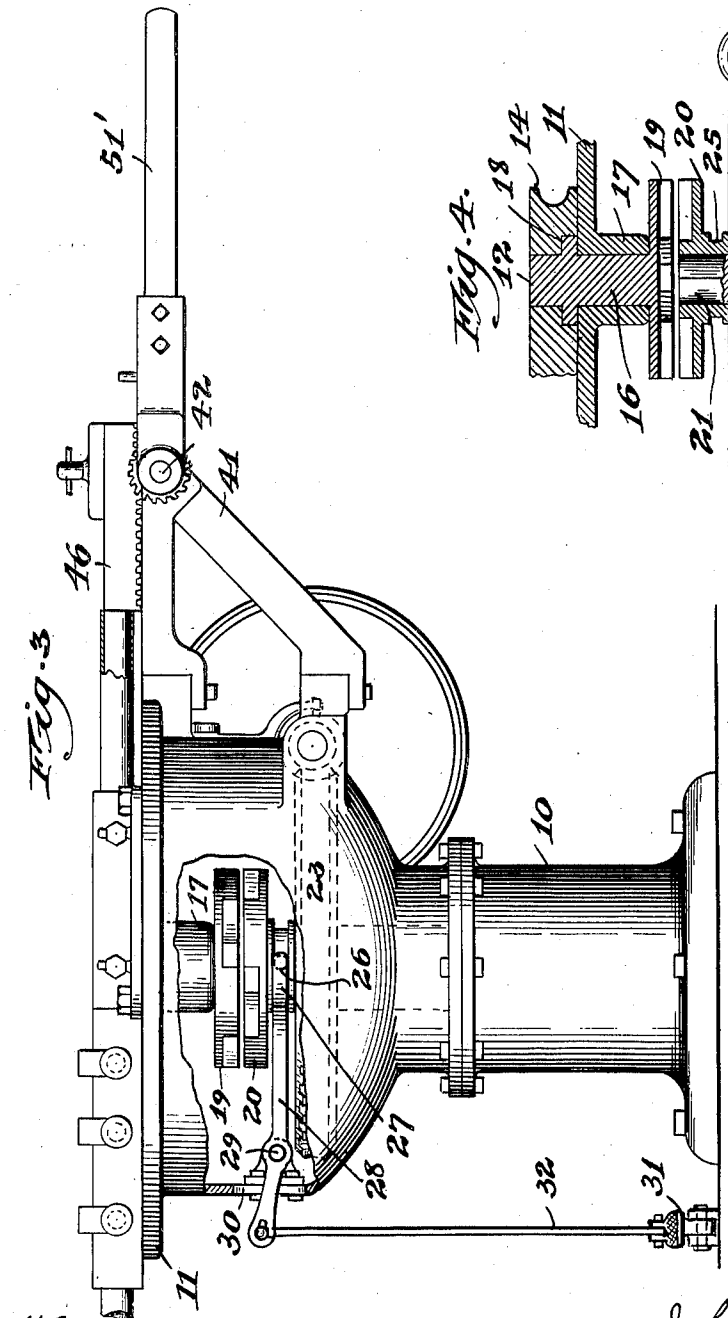

Fig. 3.

Fig. 4.

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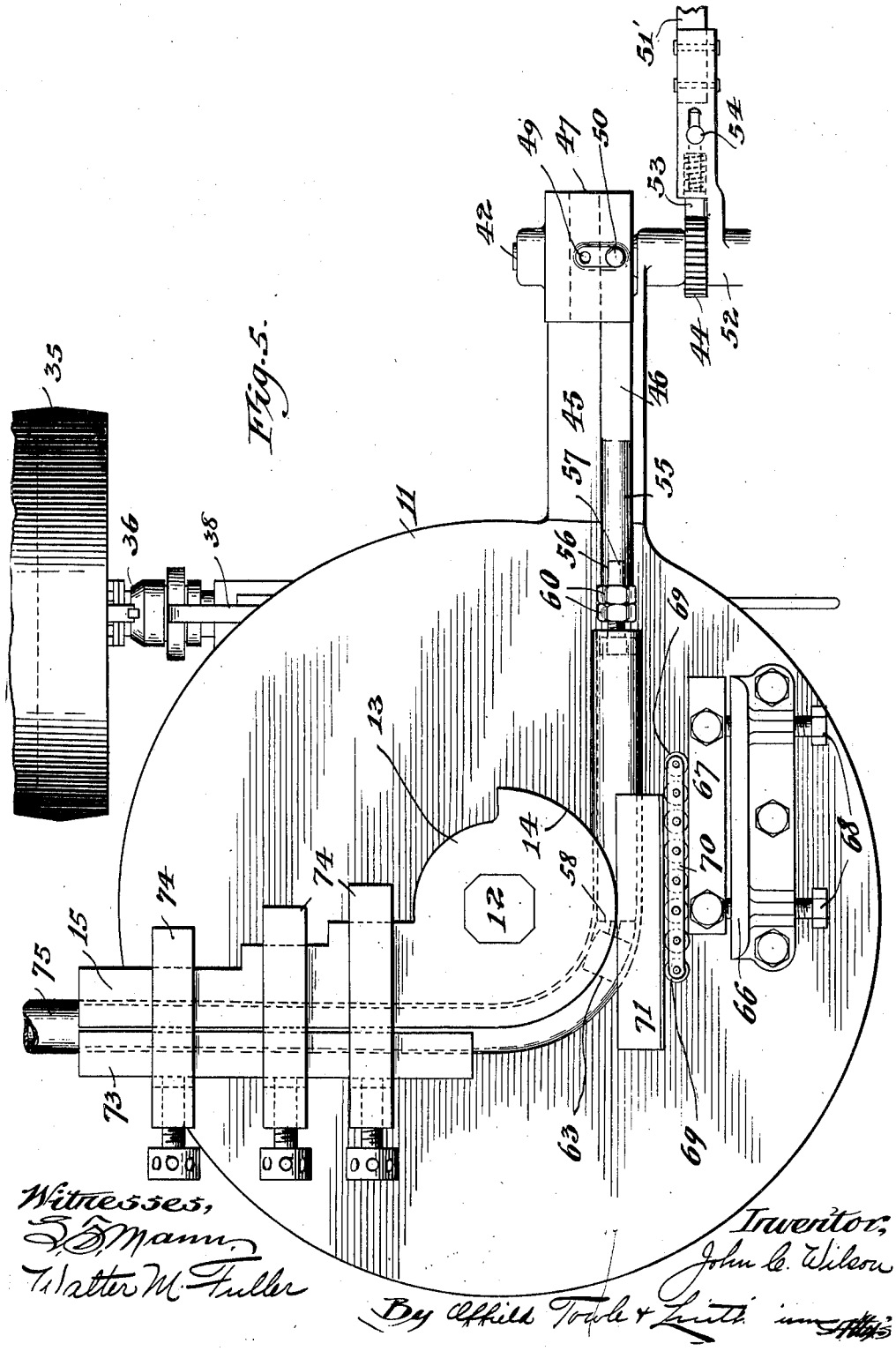
Fig. 5.



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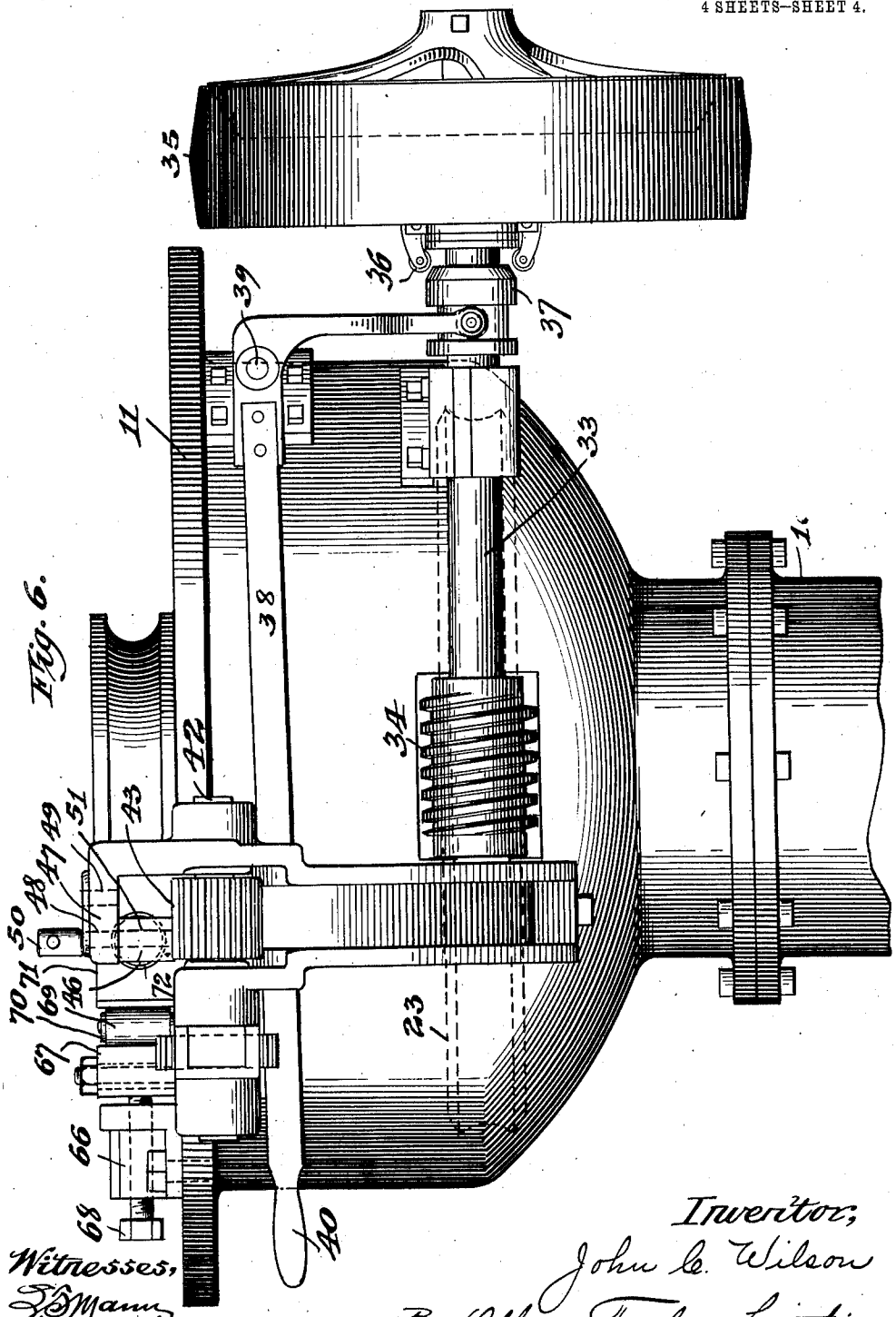

Fig. 6.

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UNITED STATES PATENT OFFICE.

JOHN C. WILSON, OF KENOSHA, WISCONSIN, ASSIGNOR TO THE SIMMONS MANUFACTURING COMPANY, OF KENOSHA, WISCONSIN, A CORPORATION OF WISCONSIN.

BENDING-MACHINE.

1,007,834. Specification of Letters Patent. Patented Nov. 7, 1911.

Application filed January 29, 1909. Serial No. 475,015.

To all whom it may concern:

Be it known that I, JOHN C. WILSON, a citizen of the United States, residing at Kenosha, in the county of Kenosha and State of Wisconsin, have invented certain new and useful Improvements in Bending-Machines, of which the following is a specification.

My invention pertains to improvements in machines or mechanisms for bending tubes, pipes, and the like, and has especial reference to the bending of tubes such as are used in the manufacture of metallic furniture, as bedsteads for instance.

One especial aim and object of my invention is to provide a mechanism which will bend such tubes and at the same time maintain the usual and unchanged cross-section of the tube at the bent portion. In other words, my invention renders possible a quick and efficient bending of the tube without causing any flattening or crushing at the bent or curved part of the same.

In the preferred form of bending machine embodying my invention, I employ a power-driven curved bender grooved on its periphery to conform substantially to the exterior convex surface of the tube, and a substantially-stationary arbor or mandrel on which the tube or pipe is placed and on which it slides during the bending operation, this arbor or mandrel having its end adjacent to the curved rotary bender tapered on a curve conforming to that of the outer portion of the interior of the curved part of the finished bent tube. Such end gives to the tube a proper initial tendency or bias to bend without collapsing or flattening as the tube is drawn off over the end, it being understood that the tube is firmly and securely clamped to the rotary bender. In conjunction with such an arbor or mandrel I have found it advisable, in some instances at least, to use one or more auxiliary or subsidiary arbors or mandrels connected to the first or main arbor and also shaped or curved to conform to the outer portion of the interior surface of the bent tube. As will be readily understood, such auxiliary arbor or mandrel also acts to prevent flattening or crushing of the tube during the bending operation. To maintain the tube in proper relation against the rotary bender, I employ a pressure block bearing against the outer face of the tube, and between such block and a fixed abutment I use a traveling roller bearing or carriage to reduce the friction, as will be readily understood. In order to assist in removing the finished bent tube or pipe from the machine, and to remove any possible defects in the end of the bent part of the tube by drawing the supplemental arbor therethrough, I provide the two arbors mentioned above with retracting means which will draw the arbors wholly or partially out of the interior of the tube or pipe.

In order that those skilled in the art may have a full understanding of this invention, I have described the same in detail below and have illustrated a preferred and desirable embodiment of the invention in the accompanying drawings, forming a part of this specification, and in which like reference characters refer to the same parts throughout the various views.

In the drawings—Figure 1 is a plan view of the improved bending machine; Fig. 2 is a fragmentary section illustrating the relation of the main and auxiliary arbors and the bent tube; Fig. 3 is a front elevation of the machine with parts broken away; Fig. 4 is a central section through the machine illustrating the driving gearing and the clutch mechanism; Fig. 5 is a plan view of the machine on an enlarged scale, parts being broken away, and shows the position and relation of the elements of the mechanism after the bending operation has been completed; and Fig. 6 is a side elevation of the machine.

Referring to these drawings, it will be noticed that the machine comprises a main support or standard 10 carrying at its upper end a substantially-circular table or top 11, centrally mounted on the top face of which on the upper angular end 12 of a short shaft 16 is a bender 13 having a substantially semi-circular periphery or edge 14 grooved, as indicated in Fig. 4, to accommodate substantially one-half of the tube or pipe to be bent. As is clearly indicated in the drawings, the bender 13 has an integral outwardly-extended arm 15 similarly grooved on its edge to accommodate the pipe or tube, this groove of course forming an extension or prolongation of the curved groove on the edge 14, as is shown for example in Fig. 5. The lower cylindrical portion (Fig. 4) of the shaft 16 is

adapted to rotate in a bearing 17 depending from the central portion of the table top 11, the shaft being held in proper relation to the table top and prevented from descending by a collar 18 fixed thereto, it being understood of course that the bender 14 is recessed to accommodate such collar. The lower end of shaft 16 carries one element or member 19 of a clutch, the other section 20 of which is fitted over and is slidable on the angular portion 21 of a stub shaft suitably secured, as by bolts 22 passing through a circular flange at the base of the shaft, to a comparatively large worm-wheel 23 rotatable on the step bearing 24. It should, therefore, be apparent that the rotation of the worm-wheel 23 is transmitted to the clutch element 20 through the squared portion 21 of the stub shaft and that this section or member of the clutch may be slid up into engagement with the member 19, thereby compelling the rotation of the bender 13 on the top of the table. When the parts, however, are in the position shown in Fig. 4 the elements of the clutch are separated and the rotation of the worm 23 is not transmitted to the bender.

The clutch element or member 20 has a grooved hub 25 in the groove of which is adapted to fit engaging pins 26 in the arms 27 at the bifurcated end of an operating lever 28 fulcrumed within the main supporting collar 29, one end of the lever projecting to the outside of the machine through a slot or opening 30. This protruding part is connected to a foot-lever or treadle 31 by a connecting link 32. By operating this foot lever the clutch element 20 may be raised into engagement with the companion clutch member 19, and upon releasing the foot lever the member 20 will drop out of engagement with the member 19, due to the weight of the parts.

At the side of the machine and rotatable in suitable bearings I employ a driving shaft 33 equipped with a worm 34 meshing with the teeth of the worm-wheel 23 and also supplied with a driving pulley 35 and a clutch mechanism 36, whereby the loose driving pulley 35 may be operatively connected to or disengaged from the driving shaft 33. The sliding sleeve 37 of this clutch is operable by a bell-crank lever 38 fulcrumed on the frame of the machine at 39 and equipped at its opposite end with a handle 40. Since this clutch mechanism forms no part of my invention, a description of the details of its construction is of course entirely unnecessary.

At the outer end of a suitable bracket or support 41 I provide a rotary short shaft 42 equipped with a pinion 43 and a ratchet wheel 44 fixed to and movable with the shaft. The top part 45 of this bracket 41 constitutes a lateral extension of the table-top 11, and slidable on the same is an inverted rack 46, the teeth of which mesh with those of the pinion 43, the top surface of the rack being flat and plane and passing beneath an overhanging bracket arm 47 which acts to maintain the rack in mesh with the pinion. This arm 47 has extended therethrough one or more vertical holes, in the present instance two, characterized 48 and 49. I supply the device with a locking pin 50 adapted to be passed through either one of these holes into an aperture 51 of the rack so as to lock the rack against movement under certain conditions. A pinion and shaft operating handle 51′ is loosely mounted at one end 52 on the shaft 42 beside ratchet 44, this handle carrying a spring-actuated pawl or dog 53 equipped with a knob 54 by which it may be retracted manually out of the path of the teeth of the ratchet 44. As will be readily understood, with the pawl or dog in operative connection with the ratchet, the shaft 44, pinion 43, and rack 46 may be actuated. The rack 46 has an integral cylindrical extension 55 supplied at its end with a screw-threaded aperture or recess 56 intended to receive a portion of a reduced threaded extension 57 of a main cylindrical arbor 58 equipped at its adjacent end with an angular head 59, the threaded stud or extension 57 being equipped with a pair of jam or lock nuts 60 to prevent unscrewing of the parts. It will be readily understood from this construction that by loosening the nuts 60 and turning the arbor 58 and its threaded stud 57, by applying a wrench to the hexagonal head 59, the arbor may be adjusted longitudinally with relation to the rack 46, such adjustment of course being maintained by the nuts 60. This arbor is cylindrical and of substantially the same diameter as the interior of the tube to be bent, the extension 55 of the rack 46 being of the same cross-section. As is clearly illustrated in Fig. 2, the free end of the arbor 58 is tapered at 61 so as to agree with the curvature of the outer portion of the interior surface of the bent tube, the object of this tapering being to give the tube the proper shape as it leaves the end of the arbor so as to eliminate the possibility of the tube crushing or flattening during the bending operation.

Referring to Fig. 2, it will be noticed that connected to the free end of the arbor or mandrel 58 by a link 62 I provide an auxiliary or supplemental arbor or mandrel 63, the greatest cross-sectional diameter of which is substantially equal to that of the aperture through the tube, this auxiliary arbor being curved longitudinally so as to conform to the curvature of the outer portion of the interior surface of the finished bent part of the tube or pipe. This auxiliary mandrel assists in preventing flattening,

crushing, or creasing of the tube during the bending operation, and although I have indicated in the drawing only a single one of such arbors, it is to be understood that a plurality of them suitably connected together may be used if found to be desirable or necessary. In the construction illustrated, the link 62 at its opposite ends has enlarged heads at 64 which are pivoted to the respective arbors internally by means of pivot pins 65.

Bolted to the top face of the table 11 is a bracket 66, adjustable on which is an abutment bar 67, the adjustment being accomplished by means of a pair of screws 68. The abutment block or bar is arranged substantially parallel to the arbor 58, its proximate or adjacent surface being plane, and adapted to travel on its face I employ a roller bearing comprising a plurality of rollers 69 rotatably mounted in any suitable form of frame 70, the rollers on one side being adapted to contact with a face of the abutment 67 and on their opposite side on the pressure bearing block 71 recessed on its front face at 72 to accommodate a portion of the tube to be operated upon, the shape of the recess corresponding to the convex curvature or surface of the tube or pipe.

In order to fasten the tube or pipe to the arm or extension 15 of the bender 13, I provide a clamp block 73 recessed on one face to accommodate the tube and a plurality of clamps 74 of any suitable and desirable construction, these clamps being adapted to hold the parts 73 and 15 in gripping engagement with the tube 75, as is clearly illustrated in Figs. 1, 3 and 5.

The operation of this bending mechanism is substantially as follows: Assuming that the bender 13 is in the position shown in Fig. 1, with its extension or arm 15 parallel with the arbor 58 and its actuating rack 46, the tube 75 to be operated upon is slipped over the auxiliary and main arbors or mandrels 63 and 58, respectively, and the cylindrical extension 55 of the rack until the end of the tube strikes the end of the rack, as is illustrated in Fig. 3, this end of the rack operating as a stop or abutment for the proper positioning of the tube. Of course, other suitable stops might be used to effect this result, but I find that the arrangement shown and described operates satisfactorily and conveniently. It is, of course, to be understood that the pressure bar or bearing block 71 and the roller bearing 69 are in place as shown in Fig. 1, the curved recess of the pressure block receiving a portion of the tube while this block together with the roller bearing and the abutment properly hold the tube in the groove of the bender. The clamp block 73 is then applied to the tube, as shown in Fig. 1, the clamps being put in place and tightened so that the tube cannot slip relatively to the bender and its extension 15. The pin 50 is in position in one of the holes 48 or 49, in the present instance 48, extending downwardly into the aperture 51 of the rack 46, thereby locking the latter and the arbors connected therewith from movement. Assuming that the clutch 36 is in such position that the rotation of the driving pulley 38 is transmitted to the shaft 33, worm 34, worm wheel 23, and clutch member 20, all these parts revolving, it will be apparent that when the operator or workman steps upon the treadle 31 he will lift the clutch element 20, bringing the same into operative engagement with the companion clutch member 19, so that the rotation of the parts is transmitted to the bender, which turns in a clock-wise direction, as the table top is viewed in Fig. 1, approximately 90° or to any other extent desirable, when the operator releases the treadle 31, causing a cessation of the turning or rotation of the bender and the attached tube. During this turning of the bender the tube is slid along or over the cylindrical extension 55 and the arbor 58, being bent around a portion of the semi-cylindrical periphery 14 of the bender, as is clearly illustrated in Fig. 5. As the successive portions of the tube thus slide off over the tapered end of the arbor or mandrel 58, this end gives them an initial direction of movement which tends to eliminate any possibility of the bent portion of the tube being flattened or crimped. In other words, this tapered end of the arbor directs the parts of the tube in the proper direction as they pass over the same. In order more effectively to prevent any collapsing or creasing of the bent part of the tube, the auxiliary or supplemental arbor or mandrel 63 is employed to iron or wipe out any creases or imperfections which may occur, this auxiliary arbor also assisting in giving the successive portions of the tube the proper direction of travel to form the desired bend. If more than one supplemental mandrel is required or desired they may be readily linked or otherwise connected together as will be readily obvious. After the bending operation has been completed, as indicated in Fig. 5, the main and auxiliary arbors or mandrels may be wholly or partially withdrawn from the bent tube by rotating the shaft 42 by means of the pawl equipped handle 51 so as to retract the rack and the arbors connected thereto. Under ordinary conditions it is necessary to retract the arbors only a comparatively small amount, since the tube can be easily taken off after it has been unclamped. During the bending operation the tube is held in firm contact with the curved bender, and prevented from becoming distorted by means of the pressure

block 71 bearing against its outer surface, this block traveling with the tube, as will be readily understood from a comparison of the relation of the parts shown in Figs. 1 and 5, the roller bearing reducing to a minimum the friction between the block and the adjustable abutment 67.

This machine is designed to be capable of bending tubes of different diameters, and consequently the bender 13 is made detachable from the shaft 16, being replaced by any other suitable bender capable of successful operation with a smaller or larger tube, it being understood that the curved groove on the periphery of the bender should conform to the external surface of the tube operated upon. The main and auxiliary arbors are also made detachable, since they must conform in shape and diameter to the tube being bent, and the block 71 may be replaced by any other supplied with a groove on its face to accommodate the tube to be bent. In order that such tubes of different diameters may be bent by this machine, and since the position of the arbors must be varied toward or from the axis of the bender, I make the pinion 43 considerably wider than the rack so that the latter may be moved along on the pinion to the proper position for successful operation with the particular tube to be bent.

While I have herein described and shown the details of construction of this preferred embodiment of the invention, it is to be understood that the latter is susceptible of a variety of embodiments and that the invention is not limited to the structural details set out, since the minor mechanical features of the machine may be varied within wide limits without departing from the heart and substance of the invention.

I claim:

1. In a bending machine, the combination of a rotary bender, means to secure the tube to be bent thereto, a main arbor adapted to fit in said tube and on which the latter slides as the bender turns, one end of said arbor being adjacent to said bender and tapered on a curve substantially like that imparted to the outer portion of the interior surface of the tube, an auxiliary arbor curved substantially like that imparted to the outer portion of the interior surface of the bent tube, means connecting said arbors together, means to retract said arbors, an abutment, a bearing block adapted to press against said tube and travel therewith, and a roller bearing interposed between said bearing block and abutment.

2. In a tube bending machine, the combination with a rotary bender, of means to secure the tube to be bent thereto, a main arbor adapted to fit in said tube and on which the latter slides as the bender turns, one end of said arbor being adjacent to said bender and having a fixed portion tapered on a curve substantially like that imparted to the outer portion of the interior surface of the tube, an auxiliary arbor tapered substantially like the fixed portion of the main arbor, said auxiliary arbor being flexibly connected to the main arbor, means for locking said arbor against longitudinal movement while the bender is being rotated, means for retracting said arbors after the tube is bent, an abutment, a bearing block adapted to press against said tube and travel therethrough, and a roller bearing interposed between said bearing block and abutment.

3. In a bending machine, the combination of a rotary bender, a main arbor adapted to fit in the tube to be bent, an abutment, a bearing block adapted to press against said tube and travel therewith, and a plurality of bodily traveling rollers interposed between said bearing block and abutment, and means for limiting the lateral movement of said bearing block and abutment.

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