(No Model.)

2 Sheets—Sheet 1.

L. H. BRINKMAN.

TUBE BENDING MACHINE.

No. 559,839. Patented May 12, 1896.

FIG. 1.

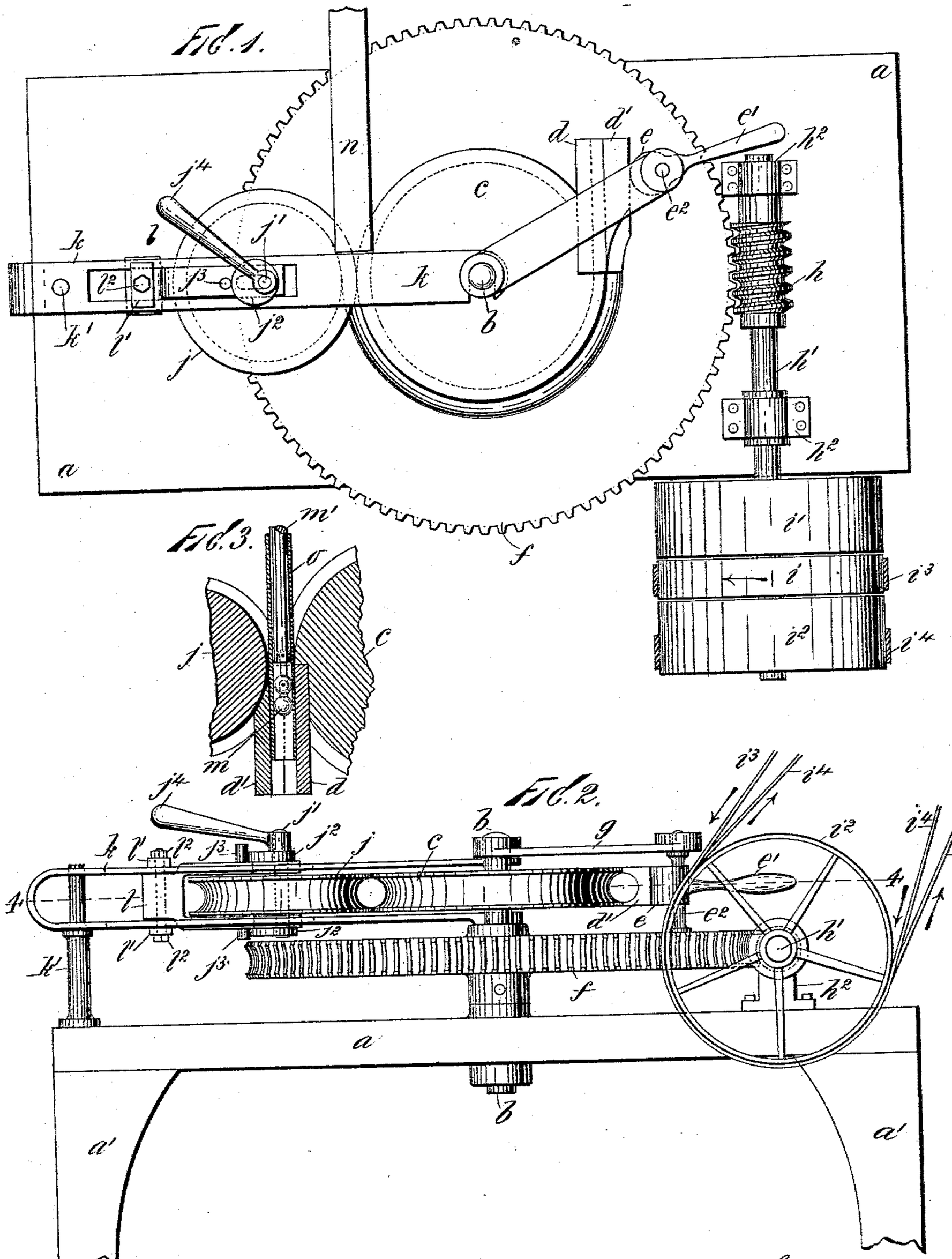

FIG. 3.

FIG. 2.

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(No Model.) 2 Sheets—Sheet 2.

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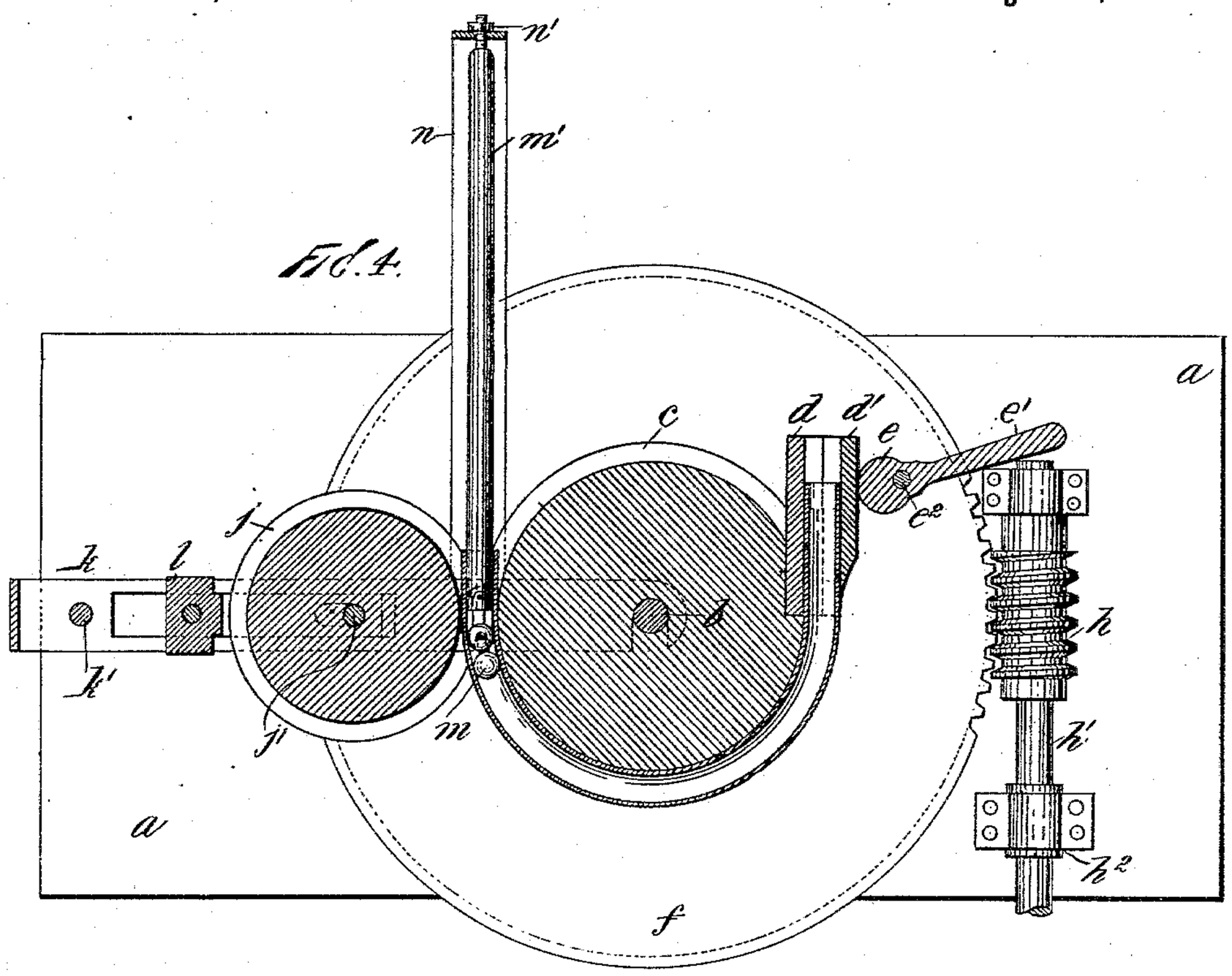

FIG. 4.

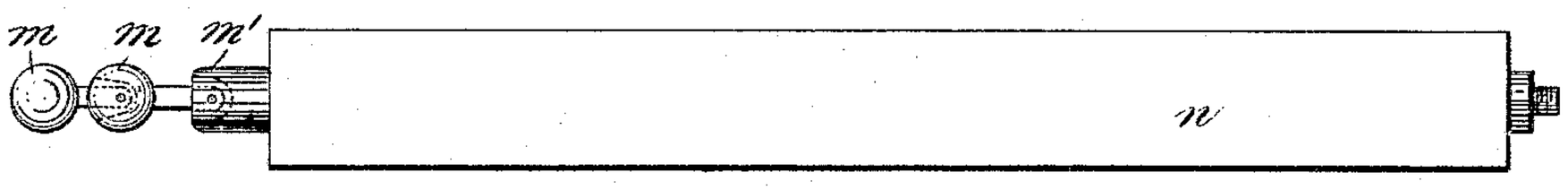

FIG. 5.

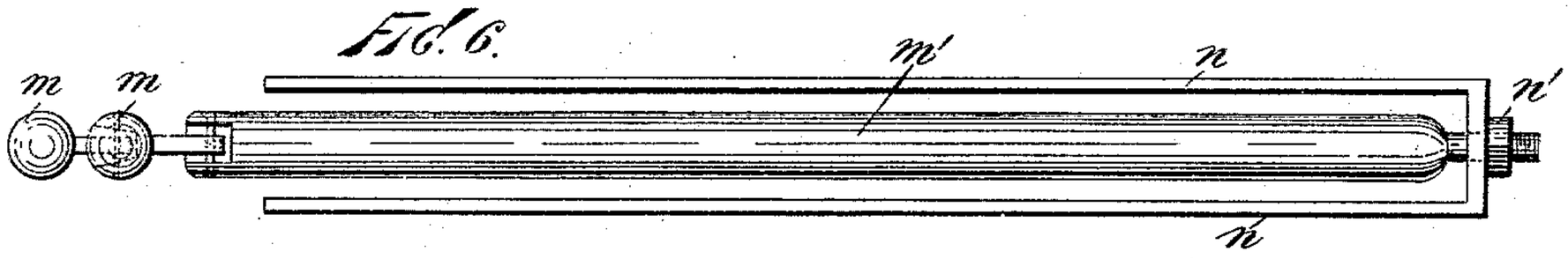

FIG. 6.

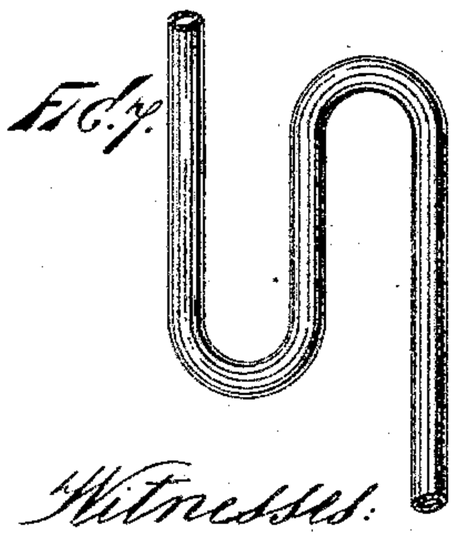

FIG. 7.

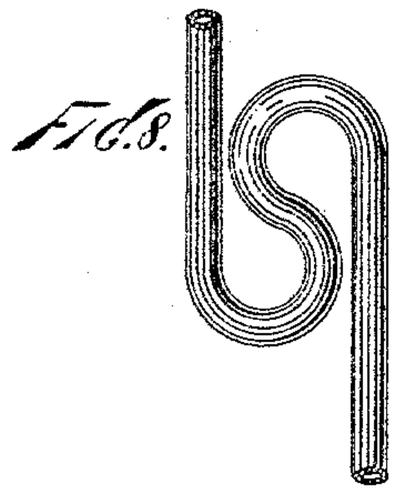

FIG. 8.

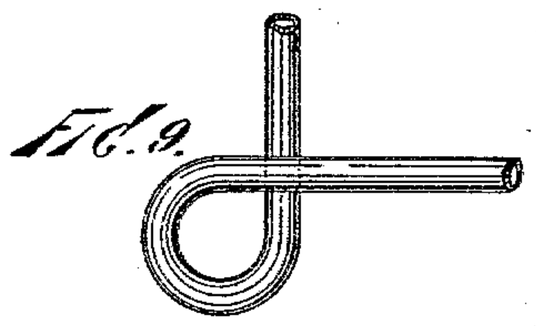

FIG. 9.

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UNITED STATES PATENT OFFICE.

LOUIES H. BRINKMAN, OF BROOKLYN, NEW YORK, ASSIGNOR TO THE PLUMBERS' SUPPLIES MANUFACTURING COMPANY.

TUBE-BENDING MACHINE.

SPECIFICATION forming part of Letters Patent No. 559,839, dated May 12, 1896.

Application filed February 11, 1895. Serial No. 538,057. (No model.)

To all whom it may concern:

Be it known that I, LOUIES H. BRINKMAN, a citizen of the United States, and a resident of Brooklyn, Kings county, State of New York, have invented certain new and useful Improvements in Tube-Bending Machines, of which the following is a specification, reference being had to the accompanying drawings, forming part hereof.

This invention relates to machines or apparatus for bending or curving pipes or tubes, and the machine or apparatus embodying this invention is particularly well adapted for bending to curvilinear form pipes or tubes of comparatively hard metal, such as hard-drawn brass tubing, and is also particularly adapted for operating upon smooth and polished tubing, as the bending operation performed in my machine does not mar or deface the surface of the tubing.

In a machine embodying my invention a guide is provided for the outside surface or outer periphery of the tube and a mandrel is provided to fit within the tube, and these outer and inner guides are arranged at or near the bending-point and act to hold the tube from collapsing or stretching out of its proper cross-sectional shape, and a clamp is provided adapted to draw or pull the tube through the guides, said clamp being movable in advance of the bending-point and being actuated to cause the proper movement required for the bend or curve to be imparted to the tube.

According to my invention a rotating former may be provided and the clamp may be movable with said former, and the former will constitute part of the guide for the outer periphery of the tube, and a guide-roller may coöperate with the former and with it constitute a guide for the entire outer periphery of the pipe or tube at or near the bending-point.

My invention includes other features more particularly set forth in the following description and claims, and shown in the accompanying drawings.

The drawings show a machine embodying my invention and also several forms of curved tubing which may be bent or curved by such a machine.

Figure 1 is a plan view of the machine. Fig. 2 is a front elevation of the same. Fig. 3 is a part horizontal section showing the clamp, former, and guide-roller at the commencement of the bending operation. Fig. 4 is a horizontal section of the machine, taken on the line 4 4 of Fig. 2. Fig. 5 is a separate plan view of a yoke for holding the mandrel, and Fig. 6 is an elevation of the same. Fig. 7 shows a double-loop or **S** trap, such as may be bent or curved from a straight tube by the machine. Fig. 8 shows another form of such trap. Fig. 9 shows a single-loop trap, such as may be bent or curved from a straight tube on my machine.

The several working parts of the machine are shown as supported by a frame including the table or bed *a* and legs *a' a'*. The main shaft or spindle of the machine *b*, upon which is held the former, is arranged vertically and is held in a bearing in the bed *a*. The former *c* is secured upon the shaft *b* near the upper end of said shaft and is shown as of circular form and provided with a peripheral groove of semicircular cross-section. A clamp is provided for gripping the tube and pulling or drawing the tube forward during the bending or curving operation, and this clamp is shown as comprising two gripping-blocks *d* and *d'* and means for clamping these blocks upon the outer surface of a pipe or tube. The block *d* is shown as set into the former *c*, so that its inner convex surface is tangential to the groove of the former, and the gripping-block *d'* is shown as a loose piece unconnected with any other part of the machine, although it is of course evident that it may have a suitable sliding connection to permit of movement toward and from the surface of the pipe or tube in the clamp. The device for tightening the clamp is shown as consisting of a pivoted cam or eccentric *e*, said eccentric being shown as provided with a handle *e'*, whereby it may be readily operated, and having its working face adapted to come in contact with the gripping-block *d'* to clamp the same upon a pipe or tube. A power-receiving wheel (shown as a worm-wheel *f*) is secured upon the shaft *b* of the former, and the lower end of the pivot-rod e^2 of the eccentric *e* has a bearing in this worm-wheel *f*, while

the upper end of said rod e^2 has a bearing in an arm g, extending from the shaft b at the extreme upper end of said shaft. Thus the clamp is movable with the former and may be readily manipulated to grip the pipe or tube or to release the pipe or tube, as may be desired.

The means for imparting motion to the former comprise the power-receiving wheel or worm-wheel f, above referred to, and the worm h meshing therewith, and said worm h is secured to or formed upon a shaft h', fitted to rotate in suitable standards h^2, extending upwardly from the bed a, and upon this shaft h' suitable driving-pulleys are shown, said pulleys including a medial fast pulley i, secured upon the shaft h', and two loose pulleys i' i^2, fitted to rotate loosely upon the shaft h', and the means for operating these pulleys is shown as consisting of two belts i^3 i^4, the belt i^3 being shown as upon the fast pulley i and the belt i^4 being shown as upon the loose pulley i^2. Said belts may be caused to impart rotative movement in opposite directions to the pulleys, as by having one belt crossed and the other straight, and a suitable belt-shifter may be employed and the belts so spaced apart that in one position, as that shown, the shaft h' will be driven forwardly, in a second position no rotary movement will be imparted to the shaft, and in a third position the rotary movement imparted to the shaft will be in the opposite direction to that shown. The construction of such belt-shifting mechanism is well known and need not be particularly described or shown. With this mechanism the former may be rotated in either direction or may be stopped at any desired point.

The means which coöperate with the former in guiding the outer surface of the pipe or tube is arranged at or near the bending-point and according to my invention may consist of the grooved guide-roller j, said guide-roller being fitted to rotate and having a groove in its periphery, which groove may be of semicircular section, as shown, and said roller being capable of adjustment, so that its grooved surface will rotate in contact with the tube at or near the bending-point and so that the former and guide-roller together encircle the entire outer circumference of the tube. As shown, the roller bears upon the tube exactly at the bending-point; but it is of course evident that the guide-roller may have a slightly-different position within the scope of my invention. The bearings of this guide-roller j are held in a swinging frame k, said frame being pivotally fitted upon the vertical pin or stud k', extending upward from the bed a, and said frame k having a hook or slot at its extreme right hand end adapted to engage with the shaft b of the former. The frame k is bifurcated, and both arms are shown as pierced by the pivot-stud k' and as embracing the former-shaft b. Thus the frame is firmly held against the strains to which it would be subjected when in the position shown, which is its working position, but may be swung rearwardly, so as to move the guide-roller j away from the former and away from the bending-point, and thus to permit free access to the former and clamp at the bending-point for adjusting the clamp and pipe or tube and preparing for or commencing the bending operation. In addition to this capability of being swung away from the former and bending-point the guide-roller is also capable of being tightly pressed against the former or against the pipe, so that its grooved surface in coöperation with the grooved surface of the former will form a guide of unvarying dimensions and capable of withstanding considerable pressure, through which guide the tube may be drawn in the bending or curving operation. Another advantageous feature of a construction embodying my invention is that the position of the rollers is adjustable for formers of different diameter, so that the same machine may be adapted for bending or curving pipes or tubes to curves of different diameter by merely removing the former and inserting another former whose diameter corresponds with the desired curvature and by adjusting the guide-roller so that it will be in proper position relatively to this former of different diameter. The adjustment of the guide-roller j to and from the axis of the former is shown as provided for by the sliding connection between the block l, which block includes the bearings of said guide-roller j, and the swinging frame k, said frame k being slotted to receive said block, and clamping-plates l' and a clamping bolt and nut l^2 being provided for holding said block in desired positions in the swinging frame k.

The block l is shown as bifurcated or yoked, so as to embrace the guide-roller j, and the arms of this yoked portion are provided with slots through which extends the pivot-pin j', upon which said guide-roller j is fitted to rotate. The upper and lower ends of this pivot-pin or shaft j' are provided with cams or eccentrics j^2 j^2, which cams or eccentrics work against fixed pins or studs j^3 j^3, projecting from the block l, or may work against other suitable projecting or engaging surfaces on said blocks. The shaft j', on which said cams or eccentrics are secured, is also shown as provided with a handle j^4, extending upward in position for convenient manipulation, and this handle may be manipulated to press the guide-roller tightly against the outer surface of the pipe or tube, and may also be manipulated to relieve the pressure upon said tube when desired, and when said handle j^4 is operated and cams j^2 are brought into action the shaft j' will move in its slots in the block l and thus move the guide-roller j toward or from the former and tube. Thus the guide-roller bearing-block l may be set by the clamping-bolt and nut l^2 in desired position for a given diameter of former, and this position of the bearing-block need not

be disturbed so long as it is used with such former, but the guide-roller may be clamped against or moved away from the tube, as desired, by manipulating the handle j^4.

A mandrel is provided to support the entire inner periphery of the tube at or near the bending-point, and said mandrel is shown as consisting of balls m m linked together and to a supporting-rod m', and these balls are of such diameter as to completely fill the cross-section of the pipe or tube, so as to support the inner periphery thereof at all points of its circumference. The arrangement shown of two of such balls, one ball located slightly in advance of the bending-point and the other ball at a greater distance in advance of the bending-point, has given the best results in practice; but it is of course evident that one or any desired number of such balls may be employed, and that the balls may be otherwise located at or in proximity to the bending-point, so as to form supports extending around the inner periphery of the tubes during the bending operation, and it is also evident that spheroidal forms may be substituted in place of the balls or spheres shown, it being only necessary that the mandrel shall be in contact with the inner surface of the tube around its entire circumference and that the mandrel shall be of such curvature longitudinally or of such flexibility as to its longitudinal curvature that it will not interfere with or prevent the bending or curving of the tube. The means for holding the mandrel in place are shown as comprising a yoke n, adapted to bear against the yoked swinging frame k, and of such length as to extend beyond the straight pipe or tube before bending, and the rod m', to which the balls m m are linked, is shown as adjustably held by the nut n'. It will frequently happen, however, that a flexible device for holding the mandrel will be necessary, and in such case a chain or cable or other suitable means may be employed, and such chain or cable or connecting-rod or other means may be otherwise held in any suitable manner in fixed, or substantially fixed, position relatively to the bending-point.

In Fig. 3 a portion of the former c and of the guide-roller j is shown, and the mandrel-balls m and the clamp for the tube are also shown, and the tube o is at the beginning of the bending or curving operation. It will be noted that the tube-clamp is so shaped as to permit the rear end of the clamp to be started exactly at the bending-point. When the parts are in this position, everything is ready for the bending or curving operation, and upon the rotation of the former the tube-clamp will move with the former in advance of the bending-point and will draw or pull the tube through the outer guide, formed by the grooves of the former c and guide-roller j, and through the inner guide, formed by the mandrel m, and the pipe or tube will thus be caused to assume the desired bent or curved shape without any possibility of collapsing or distortion, and the metal at the inner portions of the curved part will be compressed or upset, and at the outer portions of the curved part will be extended or stretched to the extent required by the curvature of the tube. The final position with a semicircular bend is shown in Figs. 1 and 4, and it will be seen that the curved portion of the tube is held by the former along the inner part of said curved portion from the bending-point to the clamp, and thus after having been curved or bent it is firmly held in curved position until the conclusion of the bending or curving operation. It is of course evident that the bending or curving operation could be continued for nearly one complete revolution of the former and thus produce a curvature approaching a circle—as, for instance, the curvature shown in the single-loop trap, Fig. 9. It will also be noted that a greater curvature could be obtained with the mechanism shown preferably by substituting for the tube-clamps shown a clamp adapted to grip a curved or bent tube and moving the former and clamp backward, so as to take a fresh grip upon the tube, and then continuing the bending operation.

Where it is desired to produce a coil of pipe of helical form, the former and guide-roller may be provided with grooves of helical form.

It will of course be evident that in the many applications and uses of this invention in producing curved or bent tubes of various forms the shape of the former and of the guide-roller and clamp will be varied as may be desirable and as will be dictated by the requirements of particular cases.

If only a semicircular bend or curve is desired, the former may be only a half-disk, and in some cases it may be desirable to cut away portions of the former or guide-roller for clearance or for other reasons. Various forms of loops or curves may be produced on my machine, and I have illustrated some of these forms in Figs. 7, 8, and 9. Fig. 7 shows an ordinary **S** loop or trap produced by two semicircular bends extending in opposite directions. Fig. 8 shows another form, in which each loop is greater than a semicircle, and the trap has loops of large diameter and yet takes up very little room. In Fig. 9 is shown a single loop extending through three-quarters of a circle.

It is of course evident that various modifications may be made in the machine above described and in the component parts thereof without departing from my invention and that parts of my invention may be used separately. I do not therefore limit my invention to the particular construction shown and above described; but

What I claim, and desire to secure by Letters Patent, is—

1. In a machine for curving or bending tubes, in combination, a rotating former, a

roller fitted to rotate in contact with the tube at or near the bending-point, a pivoted frame supporting said roller and movable to swing the roller away from the former and the bending-point of the tube in the plane of the former, and a clamp for the tube, substantially as set forth.

2. In a machine for curving or bending tubes, in combination, a rotating former, a roller fitted to rotate in contact with the tube at or near the bending-point, an adjustable block in which said roller is loosely pivoted and means for clamping said block in the desired position, and a rotatable cam for moving said roller against the tube, substantially as set forth.

3. In a machine for curving or bending tubes, in combination, a rotating former, a roller fitted to rotate in contact with the tube at or near the bending-point, a pivoted frame supporting said roller and movable to swing said roller away from the former and the bending-point of the tube, and a rotatable cam for moving said roller against the tube, substantially as set forth.

4. In a machine for curving or bending tubes, the combination of a rotating grooved former, a clamp for the tube movable in advance of the bending-point, a grooved roller fitted to rotate with its grooved surface in contact with the tube at or near the bending-point, said former and roller being shaped so as together to encircle the entire outer circumference of the tube, and a mandrel adapted to fit within the tube and to support the entire inner periphery of the tube at or near the bending-point, substantially as set forth.

This specification signed and witnessed this 7th day of February, A. D. 1895.

LOUIES H. BRINKMAN.

In presence of—
EPHRAIM MARTIN,
MYNDERT A. VOSBURGH.