No. 648,929. Patented May 8, 1900.

F. DEMING.

TUBE FORMING MACHINE.

(Application filed May 31, 1898.)

(No Model.) 4 Sheets—Sheet 1.

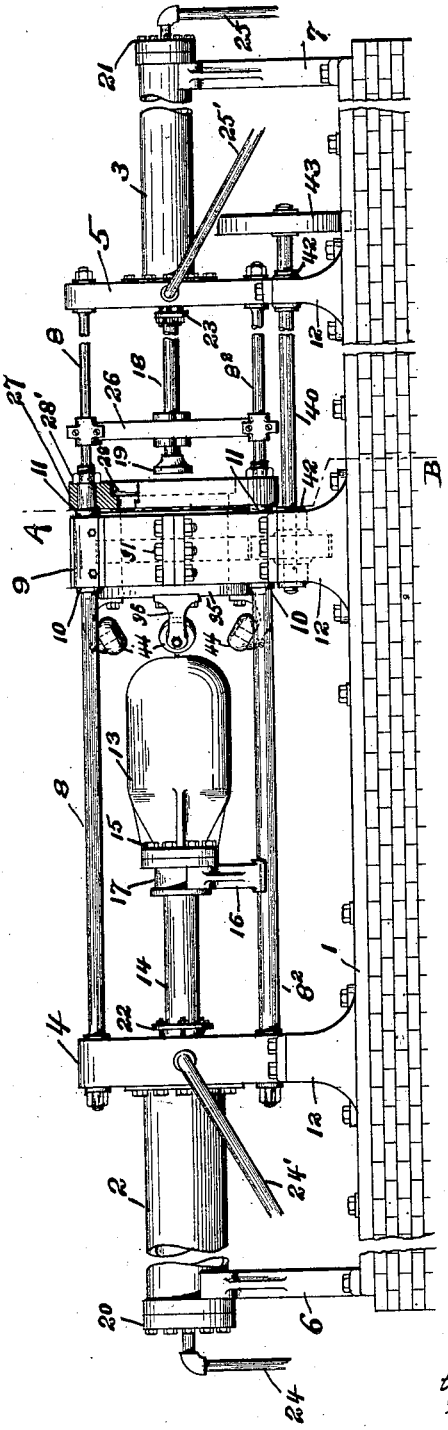


Fig. 1.

Witnesses.

J. Peter Dejon

Edwin M. Clark

Inventor.

Ferdinand Deming

by Chapman and Hall

Attorneys

No. 648,929. Patented May 8, 1900.

F. DEMING.

TUBE FORMING MACHINE.

(Application filed May 31, 1898.)

(No Model.) 4 Sheets—Sheet 2.

Fig. 2.

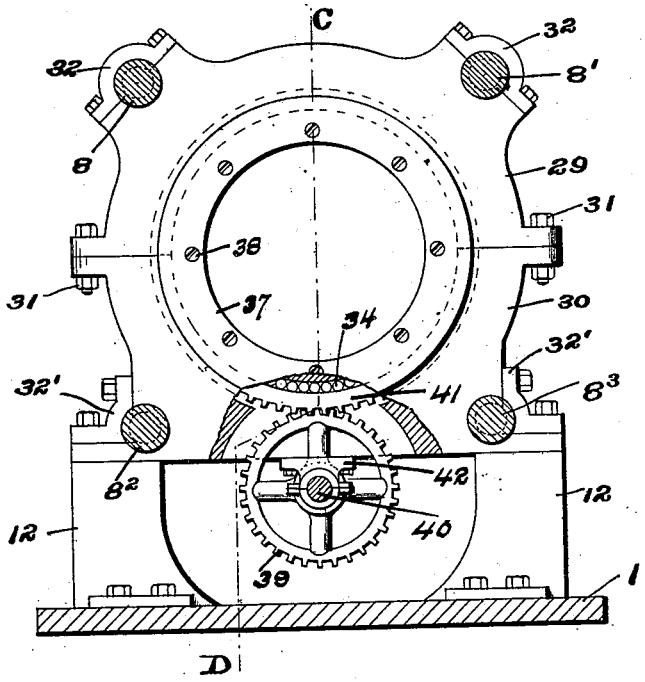
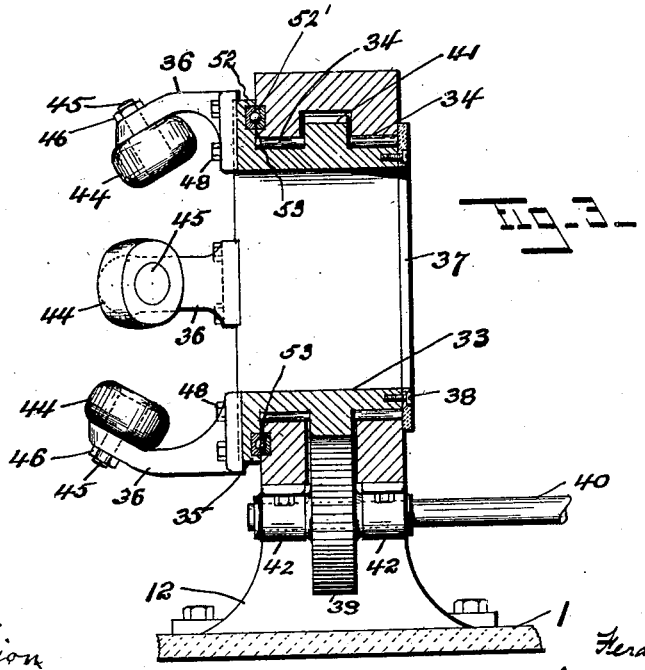


Fig. 3.



Witnesses.
J. Peter Dejon
Edwin M Clark

Inventor.
Ferdinand Deming
by Chapman and Hall
Attorneys.

No. 648,929. Patented May 8, 1900.

F. DEMING.

TUBE FORMING MACHINE.

(Application filed May 31, 1898.)

(No Model.) 4 Sheets—Sheet 3.

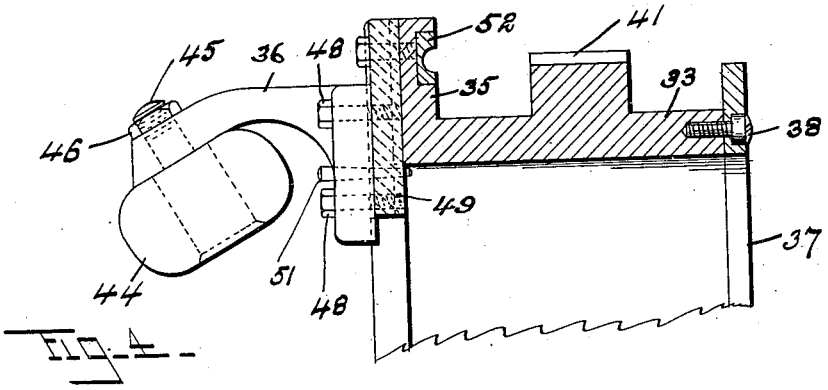


Fig. 4.

Fig. 3.

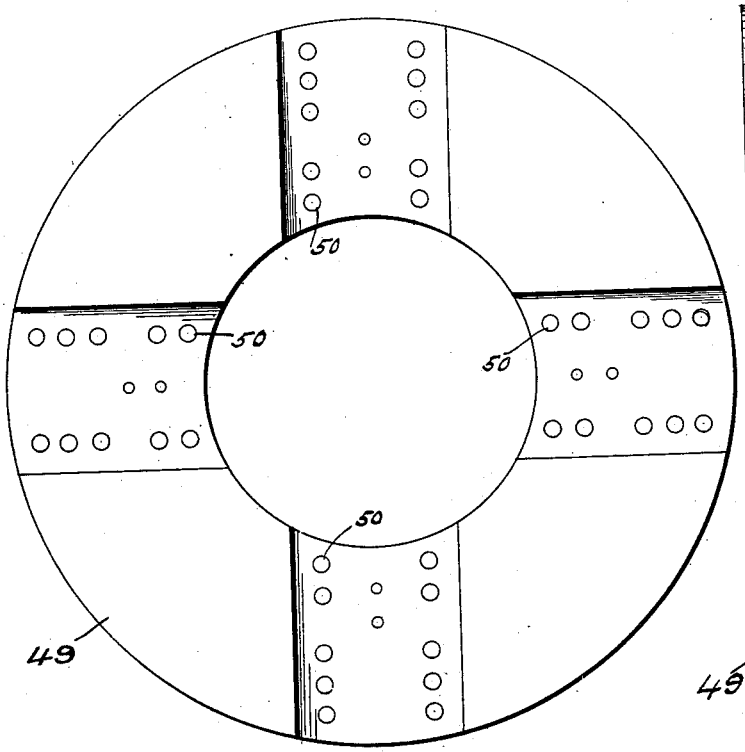
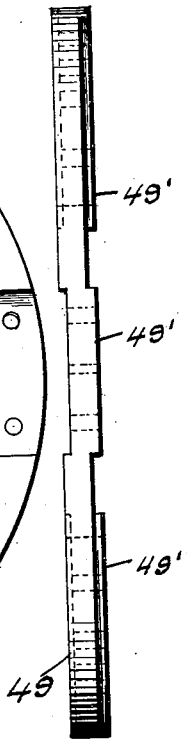


Fig. 5.



Witnesses.
J. Peter Dyon
Edwin M Clark

Inventor.
Ferdinand Deming.
by Chapman & Hall
Attorneys.

No. 648,929. Patented May 8, 1900.

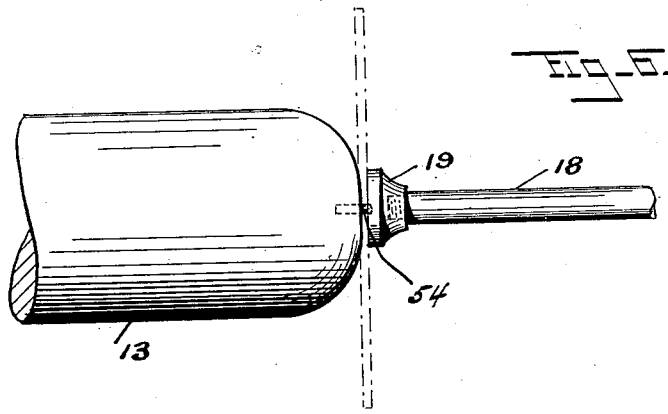
F. DEMING.

TUBE FORMING MACHINE.

(Application filed May 31, 1898.)

(No Model.) 4 Sheets—Sheet 4.

Fig. 6.



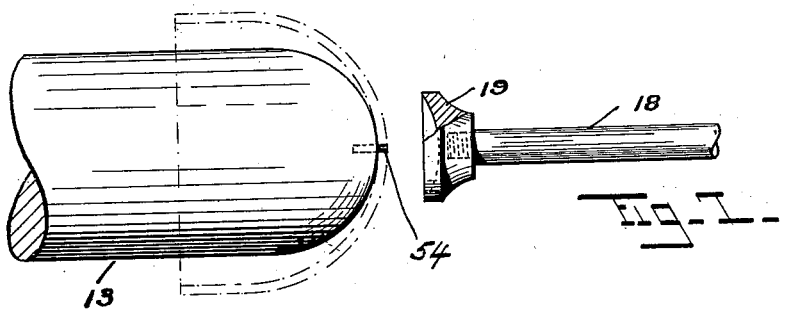


Fig. 7.

Witnesses.
J. Peter Dejon
Edwin M Clark

Inventor.
Ferdinand Deming
by Chapman and Hall
Attorneys.

UNITED STATES PATENT OFFICE.

FERDINAND DEMING, OF WATERBURY, CONNECTICUT, ASSIGNOR TO GEORGE H. CLOWES, OF SAME PLACE.

TUBE-FORMING MACHINE.

SPECIFICATION forming part of Letters Patent No. 648,929, dated May 8, 1900.

Application filed May 31, 1898. Serial No. 682,091. (No model.)

To all whom it may concern:

Be it known that I, FERDINAND DEMING, a citizen of the United States, residing at Waterbury, in the county of New Haven and State of Connecticut, have invented certain new and useful Improvements in Tube-Forming Machines, of which the following is a specification, reference being had therein to the accompanying drawings.

My invention relates to a method and apparatus for the manufacture of seamless tubing from sheet metal.

The object of my invention is to form seamless shells or tubes from sheet metal and to construct an apparatus for the same that is simple and effective in its operation, by which shells or tubes can be made of any desired diameter with the minimum number of reducing-passes.

To these ends my invention consists generally in bending or forming a blank or disk of sheet metal over a mandrel by the action of rollers which revolve around the mandrel and have contact with the said blank, thus forming a seamless tube or shell.

My invention also consists of a machine having certain combinations of parts and details of construction, as will be hereinafter set forth, and more particularly pointed out in the claims, and embodying generally a main hydraulic cylinder through which the mandrel is operated, an auxiliary hydraulic cylinder of smaller diameter than the main cylinder, by which the pressure-plate is operated, and a plurality of forming-rolls attached to a rotary carrier, the said forming-rolls coöperating to fold the plate back upon the mandrel and forming the tube.

Referring to the drawings, in which like numerals designate like parts in the several views, Figure 1 is a side elevation of the machine complete. Fig. 2 is a transverse section of Fig. 1 upon line A B, showing an end elevation of the roll-carrier frame. Fig. 3 is a section of the roll-carrier frame upon line C D of Fig. 2. Fig. 4 is a fragmentary portion of the roll-carrier with the adjusting-plate secured thereto. Fig. 5 is a front elevation of the adjusting-plate. Fig. 6 is a fragmentary view of one form of the two pistons and the pressure-plate. Fig. 7 is a fragmentary view of a modified form of the parts shown in Fig. 6. Fig. 8 is a side elevation of the adjusting-plate.

The numeral 1 designates the bed-plate of the machine, resting upon a suitable masonry foundation, 2 the main or mandrel cylinder for operating the mandrel-piston, and 3 the auxiliary or pressure-plate cylinder. These cylinders 2 and 3 are fastened at their inner ends to the bulkheads 4 and 5, respectively, and supported at their outer ends by the standards 6 and 7, secured to the bed-plate. The bulkheads 4 and 5 are joined and fastened rigidly together by the four tie-rods 8, 8′, 8^2, and 8^3. Located between the said bulkheads 4 and 5 is the roll-carrier frame 9, which is held against longitudinal displacement by the collars 10 11 upon either side of the carrier-frame and integral with the said tie-rods, which are fitted into the said carrier-frame and there held by the caps 32 32′. The bulkheads 4 and 5 and the carrier-frame 9 are mounted upon the legs 12 12, which are securely fastened to the bed-plate 1.

The numeral 13 designates the mandrel or forming-arbor, which is secured to the outer end of the piston-rod 14 by the bolts 15, said piston-rod being operated by the piston 2. The forward end of the piston-rod 14 is supported by the sliding carriage 16, which rests upon the lower tie-rods 8^2 8^3, the upper portion of said carriage being fitted into a recess 17, formed in said piston-rod. The piston-rod 18 in the cylinder 3 is of less diameter than piston-rod 14, and upon its forward end is screwed the pressure-plate 19, which may have a flat face, as shown in Fig. 6, or a concaved face, as illustrated in Fig. 7, the form of the face being governed primarily by the shape of the forward end of the mandrel 13, two forms of which are shown in Figs. 6 and 7.

The cylinders 2 and 3 are of the ordinary type used for hydraulic work, having the usual cylinder-heads 20 21, stuffing-boxes 22 and 23, and connecting-pipes 24 24′ and 25 25′.

The forward end of the piston-rod 18 is held rigidly supported by the carriage 26, which slides freely upon the tie-rods 8 8′ 8^2 8^3.

Adjacent to the rear face of the carrier-frame 9 is the stripper-holder 27, mounted upon the tie-rods 8, 8′, 8^2, and 8^3 and held

rigidly against the collars 11 by the nuts 28′. The central portion of the said stripper-holder 27 is bored out concentrically with the axis of the mandrel 13, and its rear face is counterbored at 28 to receive the stripper-rings. (Not shown.)

The roll-carrier frame 9 is constructed of two parts, an upper portion 29 and a lower portion 30, bolted together upon either side by the bolts 21.

Rotatably mounted in the roll-carrier frame 9 is the roll-carrier 33, which rotates within the said frame upon the roller-bearings 34, and upon the flange 35 of which is secured a plurality of forming-roll brackets 36. An annular ring 37 is fastened to the rear face of the roll-carrier 33 by the screws 38 and overlaps the carrier-frame to prevent endwise movement of the roll-carrier within the roll-carrier frame.

The roll-carrier 33 is rotated by the pinion 39 upon the shaft 40, intermeshing with the spur-gear 41, forming part of the said roll-carrier. This gear may be made independently of the roll-carrier and secured thereto by any of the methods common to the art; but I prefer to make it integral, as herein shown.

The driving-shaft 40 rotates within the bearings 42, which are fastened to the lower portion 30 of the roll-carrier frame 9 and the bulkhead 5. Any means may be used to drive the said shaft. In the drawings I have shown a pulley 43; but a gear may be used, if desired, and connected with the main mill-shaft.

The former-rolls 44 rotate upon the shafts 45, which are fastened to the former-roll brackets 36 by the nuts 46 at an angle to the axis of the central bore of the roll-carrier 33. Each of the said former-rolls 44 is provided with a rounded periphery, so that no sharp edges will be presented to the metal to cut or mar its surface. In the drawings I have shown four former-rolls; but it will be apparent that in some classes of work more or less can be used to advantage.

The former-roll brackets 36 are fitted into recesses in the face of the roll-carrier 33 and fastened therein by the bolts 48.

A radial adjustment of the former-rolls 44 is acquired by fastening the brackets 36 to a plate 49 and securing the said plate to the carrier 33 in the same manner as heretofore described for the brackets 36. The adjusting-plate 49 is made, preferably, of annular form, having projecting lips 49′ upon its rear face to correspond with the recesses in the face of the roll-carrier 33 and also provided with recesses in its front face for the roll-brackets. In the plate 49 is a series of tapped holes 50 for the reception of the bolts 48, thus admitting of a limited adjustment for the brackets 36, the tapered pin 51 being used to hold the bracket while being fastened in its adjusted position.

Inserted in the rear face of the flange 35 and in the front face of the carrier-frame 9 are the bearing-rings 52 52′, having oppositely-disposed semicircular recesses, within which are a plurality of balls 53, the whole forming a ball-bearing to take the end thrust when a tube is being formed.

The method by which I form tubing from blanks and the operation of my improved tube-forming machine are as follows: When at rest, the several parts of the machine occupy the relative positions shown in Fig. 1 of the drawings, the forward end of the mandrel 13 being slightly to the rear of the face of the forming-rolls and the face of the pressure-plate 19 adjacent to the stripper-holder 27. A hot-metal disk or blank having a hole pierced through its center is thrust upon the pin 54, projecting outward from the center of the mandrel 13, and the pressure-plate 19 brought up to the face of the blank by hydraulic pressure in the cylinder 3 to the position shown in Fig. 6. During the whole operation of forming the tube the pressure in the cylinder 3 is maintained at its maximum. The roll-carrier 33, carrying the forming-rolls, now begins to rotate, and the forming-rolls are carried around the mandrel or forming-arbor in a circular path concentric with the axis thereof. In some cases I prefer to have the roll-carrier rotate continuously; but, if desired, it may be started before each successive tube-forming operation. The mechanism for starting and stopping the driving-shaft is not shown, it being common in the art and not material to my invention. When the roll-carrier has begun to rotate, the mandrel 13, carrying the hot disk or blank, begins to advance, actuated by the hydraulic pressure upon the end of the piston-rod 14 within the cylinder 2. When the disk or blank comes in contact with the forming-rolls, they begin to rotate about their own axis by friction and the blank is bent or folded backward upon the mandrel 13. The mandrel continues to advance through the central bore of the roll-carrier and the forming-rolls continue to rotate about the axis of the mandrel and roll and bend the metal blank down close upon the said mandrel, thus forming a seamless shell or tube. There being a greater pressure upon the mandrel than upon the pressure-plate, due to the difference in the respective areas of the cylinders 2 and 3, the pressure-plate is forced backward as the mandrel advances, but still keeps a constant and invariable pressure upon the blank and prevents the same from becoming displaced. It will be noticed that during the pass of the blank through the forming-rolls the rolls acquire a rotary movement about their own axis and travel in a rotary and spiral path about the axis of the mandrel, thus giving a continuous sweep of the rolls around the blank and reducing the friction on the blank to a minimum. After the blank has been formed into a tube or shell around the mandrel as a result of its pass through the forming-rolls,

the pressure upon the mandrel and pressure-plate is removed, the stripper-rings are inserted in the counterbore 28 of the stripper-holder 27, the action of the mandrel is reversed, and while traveling backward the finished shell or tube is forced off the mandrel by the strippers.

I have not shown or described the stripper-rings used in forcing the tube from the mandrel, as they are well-known devices common to the art of tube-making, and any form of stripper-rings can be used in my machine.

By using smaller mandrels and making a number of successive passes through the forming-rolls the tube can be reduced by gradual stages to the desired diameter.

In Fig. 7 a form of mandrel is shown having a rounded forward end, which is a desirable form for use in all passes after the first, but is not essential.

The radial adjustment of the forming-rolls for the successive passes is acquired by the use of the adjusting-plate 49, as heretofore described.

In Fig. 1 each of the forming-rolls is shown as occupying a position equally distant from the face of the roll-carrier, and in Fig. 3 they are shown as occupying positions at varying distances therefrom. Either construction is used, the latter being preferable for the finishing pass.

Tubes drawn directly from castings are never perfect, as the metal is not uniform, being porous and unsound, and the drawing process weakens the same by disintegrating the fiber. Again, if the metal is wrought instead of cast the drawing process has the same effect upon the fiber to a greater or less degree, according to the quality of the stock, thus resulting in a weakened tube. In my improved method if a cast-metal block is heated and then drawn between rollers to the form of a disk and said disk then heated and bent and formed into a hollow tube or shell on the mandrel by the spirally-operating rollers the product is as nearly perfect as it can be made, there being no weakening of the metal or disintegrating of the fiber, such as in the drawing process.

In my machine much heavier stock can be operated upon while in a hot state than could be drawn by the old methods in a draw-bench when cold, larger reductions can be made at each pass through the rolls by having the forming-rolls rotate, wear upon the parts is reduced to a minimum, and a constant regrinding and resizing of dies are not necessary.

There are many minor changes and alterations that can be made within my invention, and I would therefore have it understood that I do not limit myself to the exact construction herein shown and described, but claim all that falls fairly within the spirit and scope of my invention; but

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

1. In a machine of the character described, having a hydraulic cylinder at either end thereof, and an upright frame midway between said cylinders and secured thereto by suitable tie-rods, the combination therewith of a piston operative within one of said cylinders and having a forming mandrel or arbor secured to its outer end, a piston of less diameter operative within the other of said cylinders and carrying a pressure-plate upon its free end, an annular roll-carrier having a spur-gear around the outside thereof, and rotatably mounted within said frame and held against endwise movement, a plurality of overhanging roll-brackets adjustably secured to one face of said roll-carrier, and a plurality of forming-rolls rotatably secured to said roll-brackets, all constructed and operating substantially as described.

2. In a machine of the character described, the combination with a hydraulic cylinder, of a mandrel or arbor of substantially the same or greater length than the finished tube, a carrier-frame rigidly secured to said cylinder, an annular roll-carrier having a bore therethrough concentric with said mandrel and provided with a flange upon one face thereof, a pinion, the teeth of which mesh into teeth upon said roll-carrier for rotating the same, a plurality of overhanging roll-brackets fixed to one face of said roll-carrier, forming-rolls rotatably secured to the outer end of said brackets, and means for advancing the said mandrel and rotating said rolls around the same at one and the same time, substantially as described.

In testimony whereof I affix my signature in presence of two witnesses.

FERDINAND DEMING.

Witnesses:

GEORGE E. HALL,

PATRICK T. O'CONNOR.