(No Model.) 2 Sheets—Sheet 1.

J. R. JACKSON & C. CARLSON.

METHOD OF AND APPARATUS FOR MAKING TUBING.

No. 459,752. Patented Sept. 22, 1891.

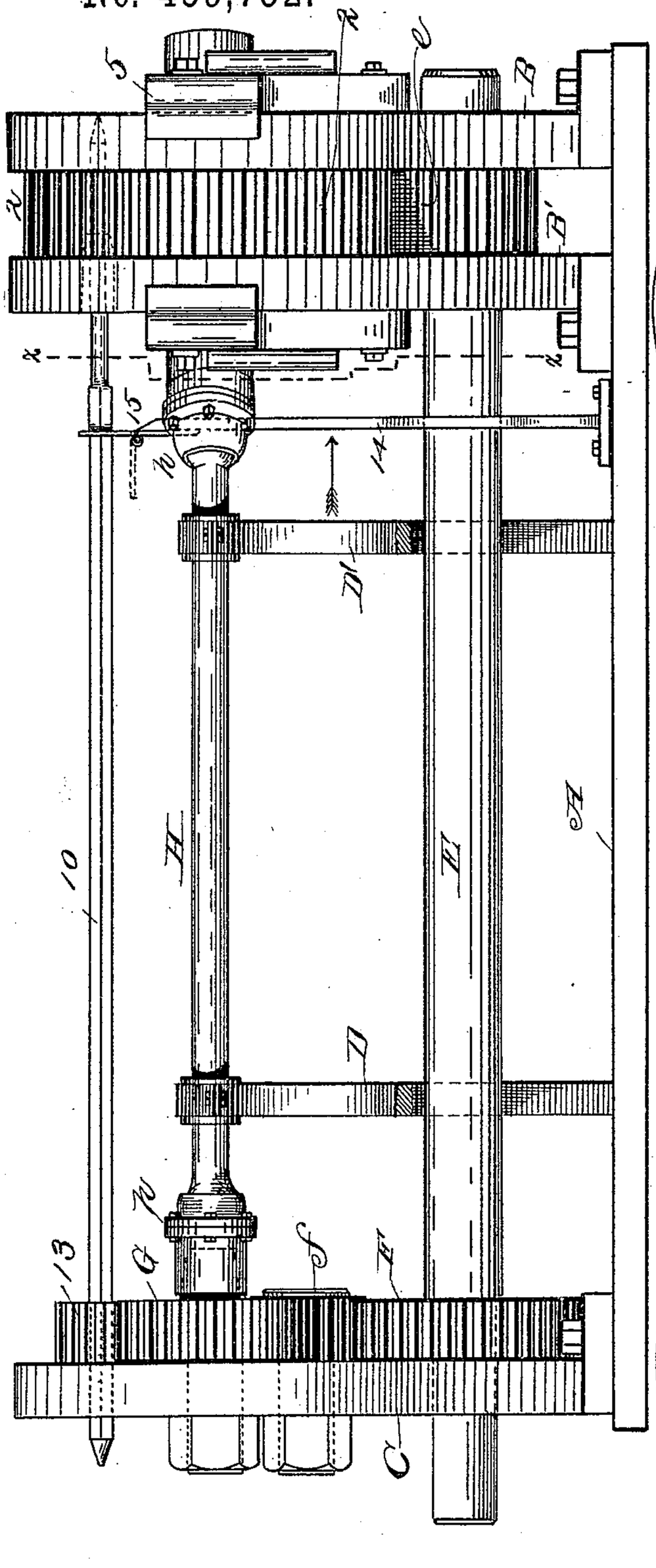

Fig. 1.

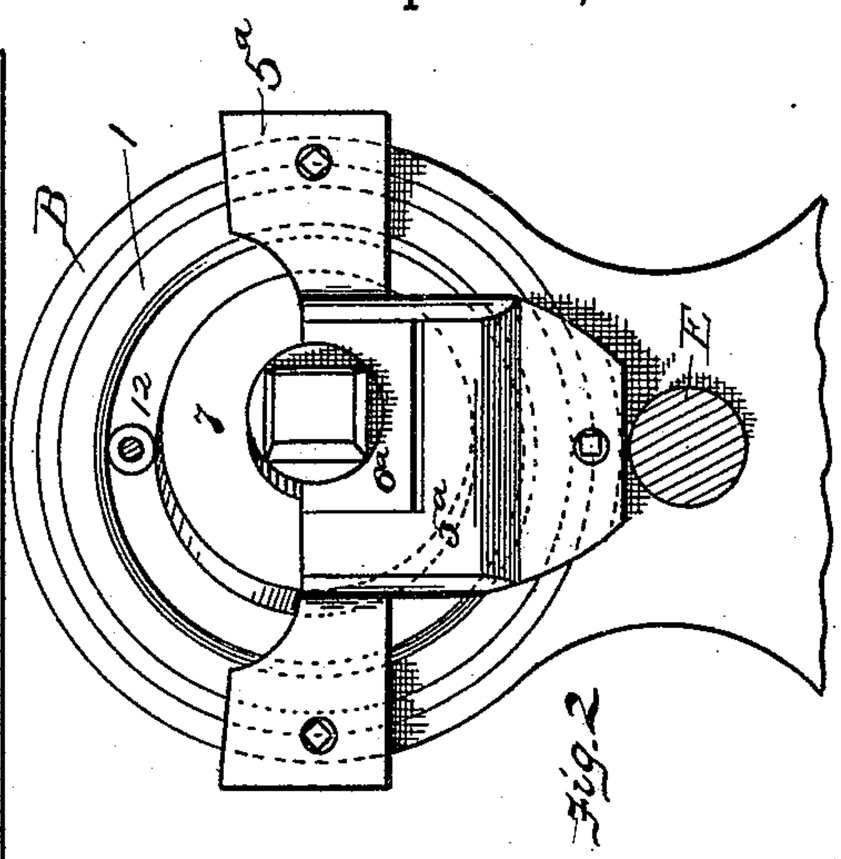

Fig. 2.

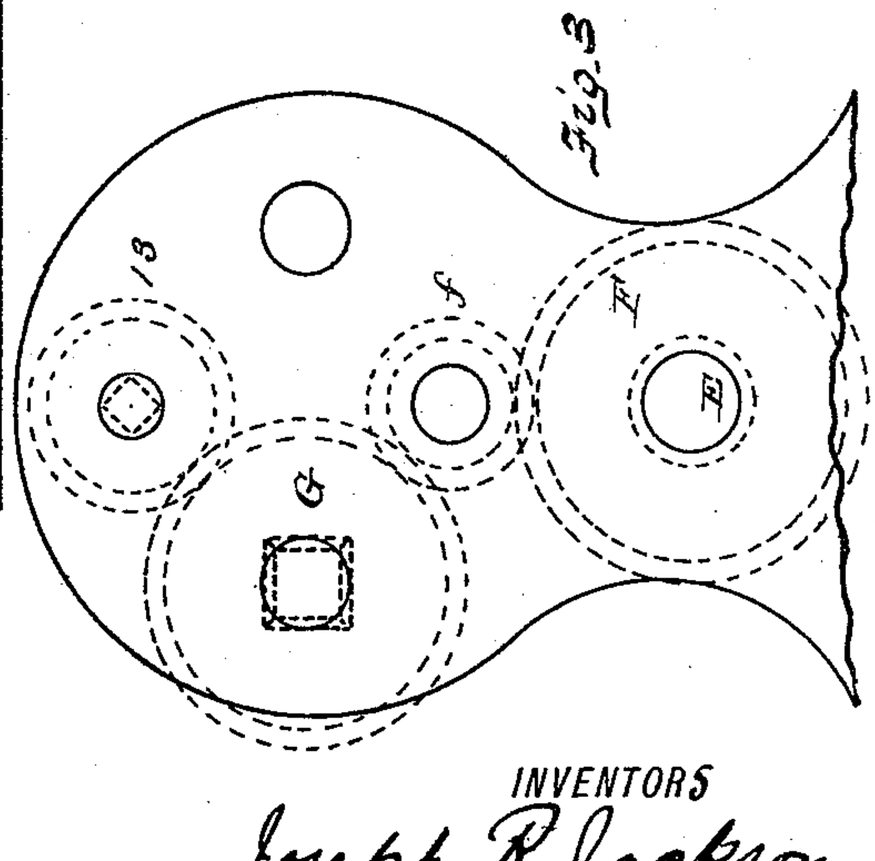

Fig. 3.

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(No Model.) 2 Sheets—Sheet 2.

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Fig. 6

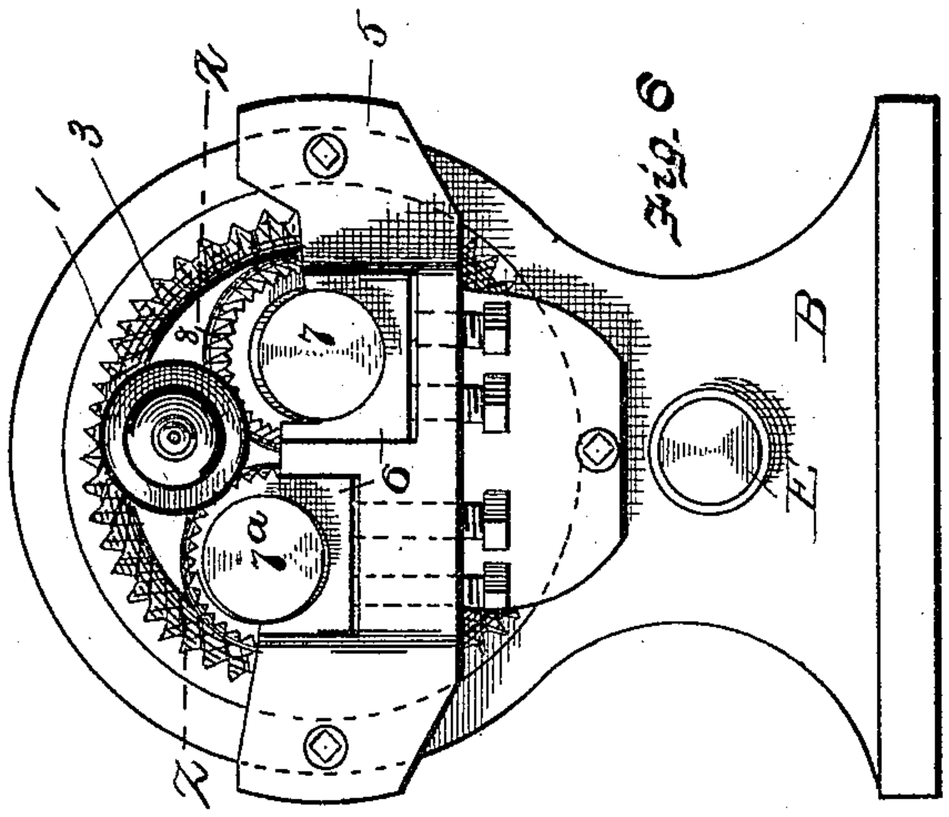

Fig. 5

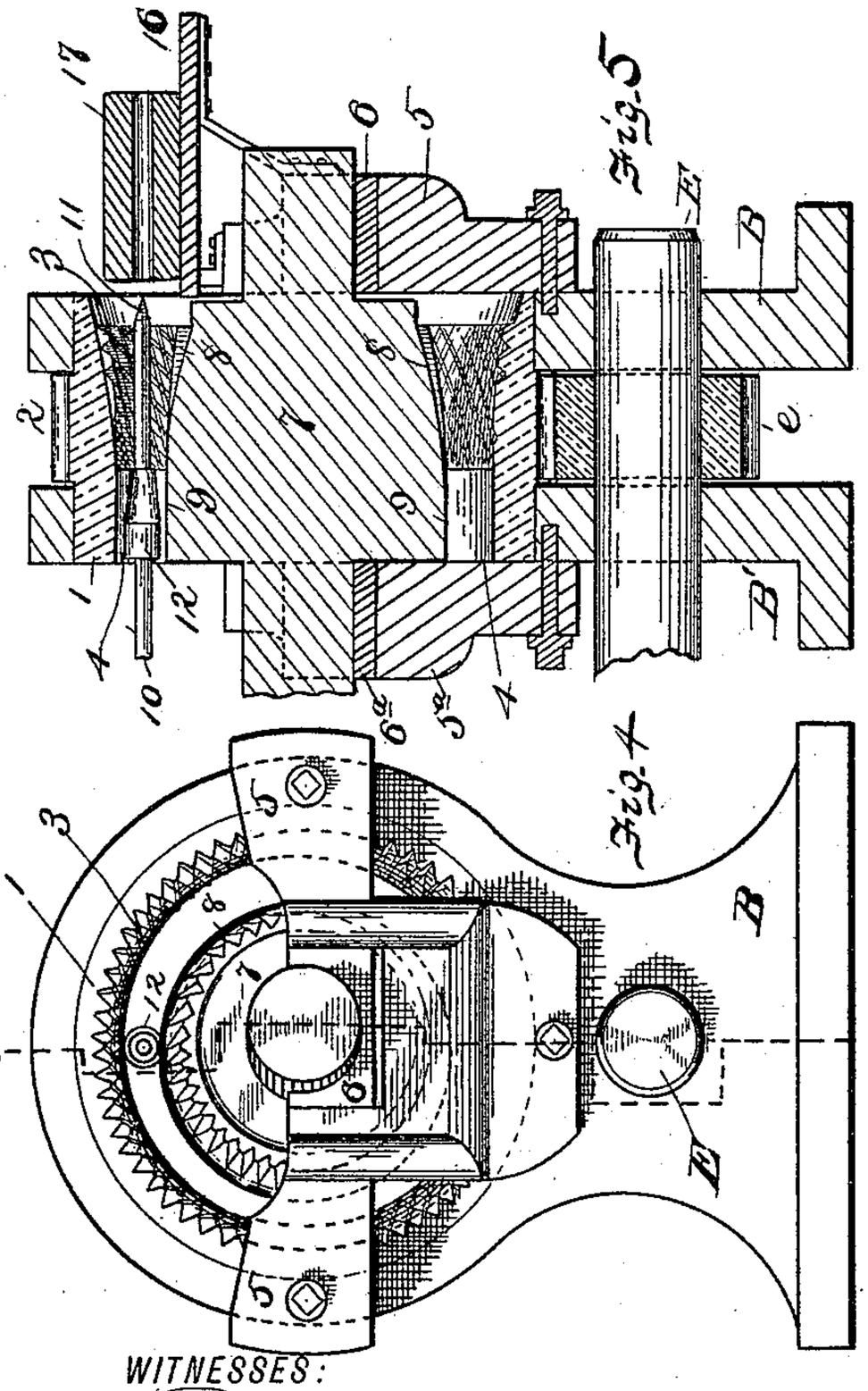

Fig. 7

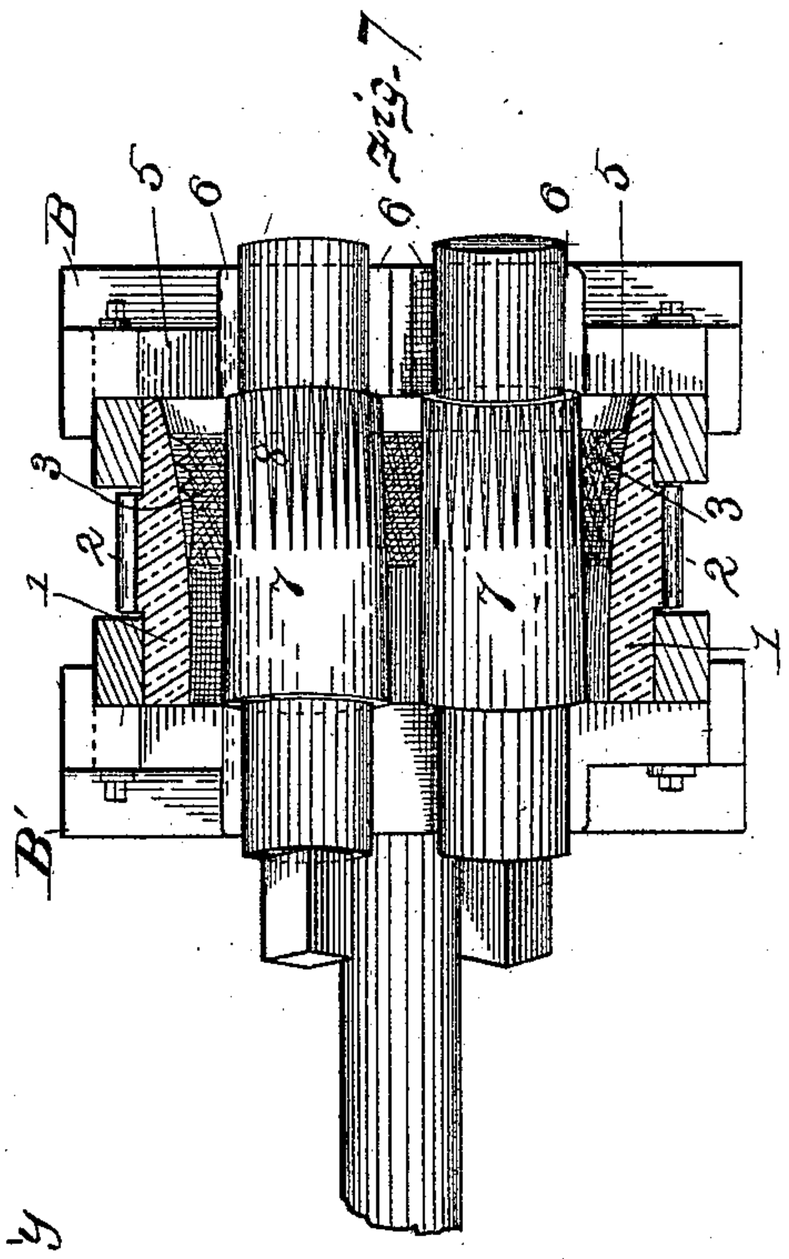

Fig. 4

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METHOD OF AND APPARATUS FOR MAKING TUBING.

SPECIFICATION forming part of Letters Patent No. 459,752, dated September 22, 1891.

Application filed February 5, 1891. Serial No. 380,375. (No model.)

To all whom it may concern:

Be it known that we, JOSEPH R. JACKSON, residing at Pittsburg, and CHARLES CARLSON, residing at McKeesport, both in the county of Allegheny and State of Pennsylvania, citizens of the United States, have invented certain new and useful Improvements in Methods of and Apparatus for Forming Tubing; and we hereby declare the following to be a full, clear, and exact description of the same, reference being had to the accompanying drawings, wherein—

Figure 1 is a side elevation of apparatus embodying our invention, portions broken away. Fig. 2 is a vertical transverse section on the line *z z*, Fig. 1, looking in the direction of the arrow and showing the finishing end of the rolls. Fig. 3 is a rear end view of the apparatus or the housing thereof, the dotted lines indicating the relation of the gearing and shafting. Fig. 4 is a front end view of the apparatus or the feed end thereof. Fig. 5 is a vertical central section of the rolls on the line *y y*, Fig. 4, part of the main power-shaft being in elevation. Fig. 6 is an elevation of the feed end of a modification of the apparatus, using two internally-placed rolls instead of one. Fig. 7 is a horizontal section taken on the line *z z*, Fig. 6, the internally-placed rolls being shown in elevation.

Like symbols refer to like parts wherever they occur.

Our invention relates to the method of forming seamless tubing and in apparatus especially adapted for carrying out said method.

The main object we have in view is to produce a roll-drawn pipe or tubing of greater strength and greater resistance to internal or bursting pressure, and this we accomplish by subjecting the tubing during the spiral-rolling operation to a rolling operation which is transverse or at right angles to the line of feed or to the line of draft, whereby the fiber of the metal is caused to arrange itself substantially transversely, and said method embraces the first or main feature of our invention. This method may be readily carried out by a revolving ring or annulus having arranged therein one or more rolls with their axes inclined to the line of feed and axis of rotation of the annulus, and said principle of construction embraces the second feature of our invention.

There are other minor features of invention, all as will hereinafter more fully appear.

We will now proceed to describe our invention more fully, so that others skilled in the art to which it appertains may apply the same.

In the apparatus shown in the drawings, A indicates a bed or foundation, on which are erected suitable main housings B B′ for the operative mechanism, rear end housing C, which, together with the housings B B′, affords bearings for the main shafting and gearing, and intermediate housings D D′ for the driving-shaft of the inclined roll or rolls.

1 indicates a revolving annulus or ring journaled in the main housings B B′ and provided on its periphery with cogs or pinion-gear 2, by which it is rotated. The feed end or front opening of the annulus is slightly bell-shaped and is preferably corrugated or spirally grooved, as at 3, to facilitate the feed of the ingot into the machine. Back of the corrugated feed portion 3 on the internal surface of the annulus 1 is a smooth working surface 4. The working surface of the annulus moves transversely or at right angles to the feed of the machine.

Extending across and secured to the front and rear of the housings B B′ are cross-pieces 5 5ª, which may be provided with adjustable boxes 6 6ª, according to the number of rolls employed, and in said boxes or, if preferred, directly on the cross-pieces 5 5ª are journaled the feed and work rolls of the apparatus, which coact with the annulus 1. For some classes of seamless tubing it may be preferable to use a single central roll, as shown in Figs. 1 to 5, while in other cases two such rolls of less diameter may be desirable, as indicated in Figs. 6 and 7. In case a single roll 7 is used its diameter will be so much less than the internal diameter of the annulus as to provide the proper working pass between the two. The roll 7 is slightly tapering or somewhat in the form of a frustum of a cone, corrugated or provided with spiral grooves at its forward end, as at 8, to coact with the like

grooves 3 of the annulus to create the grip or first catch of the rolls, and is smooth on its working surface, as at 9, to coact with the corresponding part 4 of the annulus. The roll 7 is set with its axis at a slight inclination to the line of feed and intersects the axis of rotation of the annulus 1, so that while the tendency of the annulus is to retard the feed of the tubing and roll it on its axis the tendency of the roll 7 is to feed the tubing through the machine, describing a spiral on the tubing while causing its rotation. The metal operated on will therefore be simultaneously subjected to a spiral rolling or feeding and drawing action and to a cross-rolling, the operative or working surfaces of the apparatus being arranged in juxtaposition or grouped around a common center, which is the axis of the tubing or metal operated on. These two forces coacting tend to cause the fibers of the metal to assume a substantially transverse position, which greatly adds to the required strength of the tubing.

10 indicates a mandrel, the leading end of which may be pointed, as at 11, if desired, said mandrel being provided just back of its leading end with a suitable ball 12 of tapering form, the mandrel being properly supported and arranged with its leading end 11 and ball 12 in the space between the annulus 1 and the roll 7. (See Fig. 5.) There may be any suitable and well-known provision for holding this mandrel fast; but as we prefer to rotate it positively at times we provide it with pinion 13 and journal the distant end of the mandrel in the housing C. The forward end of this mandrel is supported by means of a post 14 (see Fig. 1) and a hinged or spring catch 15, which recedes before the advancing tubing when the apparatus is at work.

The power is applied to the apparatus by any suitable means and gearing, but preferably through the medium of main power-shaft E, provided with a pinion *e*, which gears with the pinion 2 of the annulus 1, said power-shaft being provided with a pinion F, that gears with an idler *f*, the idler communicating motion through pinion G to shaft H, which drives roll 7, and also to pinion 13 on the end of mandrel 10. To accommodate the inclination of roll 7, the shaft H is connected with the shaft of pinion G and with the roll 7 by universal joints *h h* and is supported in intermediate housings D D′, as hereinbefore specified. It will be noted that the interposition of the idler *f* causes the annulus 1 and the roll 7 to revolve in reverse directions.

In case it is deemed desirable to employ two rolls 7 7ª (see Figs. 6 and 7) said rolls are necessarily of much smaller diameter but in other respects are of similar construction to the single roll 7. Their arrangement within the annulus is substantially that of the single roll 7—that is to say, their axes are in the general line of feed, but at a slight inclination thereto. Owing to their reduced size, they are arranged in or near the central plane of the annulus 1, so as to give the proper width of pass, and are reversely inclined, (see Fig. 7,) so that the lines of their axes shall intersect at a point within the working-surface of the annulus. This duplication of the rolls has its advantage in that it, taken in connection with the adjustable bearings, permits of the ready adjustment of the pass and reduces the wear on the machine and the required power for operating the same.

The gearing for driving the rolls 7 7ª may be a simple duplication of the parts G H *h h*. (Shown in Fig. 1 and previously described.)

16 indicates a suitable feed-table, and 17 a hollow ingot thereon and in position to be fed into the machine.

For the purposes of this invention a hollow cast ingot may be used, if desired, or a hollow block ingot may be previously made by welding up muck-bar, or the muck-bar at a suitable heat may be properly shaped as now practiced in the manufacture of tubing and in such condition introduced into the machine.

The method which consists, essentially, in a simultaneous spiral rolling and cross-working of the tubing is carried out in the hereinbefore-described apparatus as follows: Power having been applied to the apparatus to set the rolls and annulus in motion, an ingot 17 of suitable form (see Fig. 5) and at a welding temperature is placed on feed-table 16 and pushed on the end 11 of mandrel 10 between the roughened faces 3 8 of the annulus and roll, which draw the ingot within the machine, forcing it over the tapering ball 12 and between the working faces 9 4 of the machine. The action of the working face 9 of the roll or rolls tends to draw or elongate the tube and feeds the tube through the machine with the well-known spiral feed. This feed movement, however, is restricted and retarded by the transverse movement of the working surface 4 of the annulus, which compacts the metal and causes the fibers of the metal to assume a very close spiral or substantially transverse position, which adds materially to the strength of the tubing.

Among the advantages of the method and apparatus herein described are, first, that the metal is worked transversely, which reduces the strain on the metal, and, second, less power is required and there is consequently less strain or wear and tear on the machine.

Having thus described our invention, what we claim, and desire to secure by Letters Patent, is—

1. The method herein described for forming tubing, which consists in subjecting a hollow ingot to spiral rolling and cross-rolling simultaneously applied to the article in the same cross-sectional plane, substantially as and for the purposes specified.

2. In a machine for forming tubing, the combination, with a rotary annulus having an interior working surface, of one or more rolls arranged therein with their axes inclined

to the axis of rotation of the annulus, substantially as and for the purposes specified.

3. In a machine for forming tubing, the combination, with a rotary annulus having a corrugated bell-mouth, of one or more tapering rolls arranged therein with their axes inclined to the axis of rotation of the annulus, the leading end of said roll or rolls being corrugated, substantially as and for the purposes specified.

4. In a machine for forming tubing, the combination, with a rotary annulus, of a roll arranged therein with its axis inclined to the axis of rotation of the annulus, a mandrel provided with a ball, said ball arranged in the space between the roll and the annulus, and means for rotating the roll, annulus, and mandrel, substantially as and for the purposes specified.

In testimony whereof we affix our signatures, in presence of two witnesses, this 4th day of February, 1891.

JOSEPH R. JACKSON.
CHARLES CARLSON.

Witnesses:
WILLIAM P. CASTLEMAN,
J. B. KELLEY.