J. S. LEWIS.

APPARATUS FOR ROLLING TAPERED TUBES.

APPLICATION FILED AUG. 13, 1909.

989,508.

Patented Apr. 11, 1911.

5 SHEETS—SHEET 1.

Fig. 1.

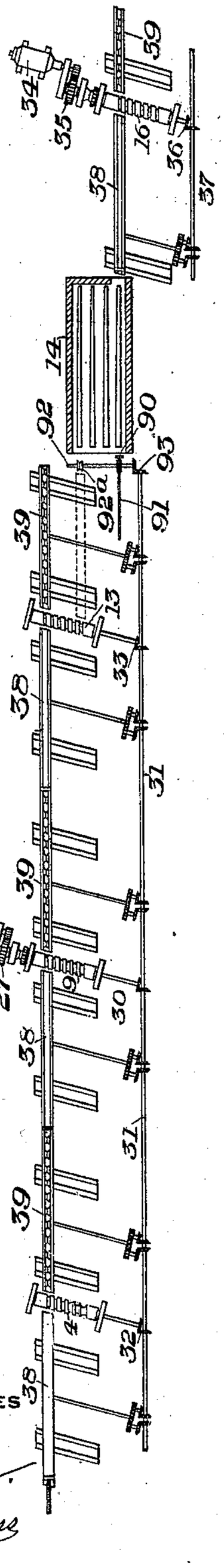
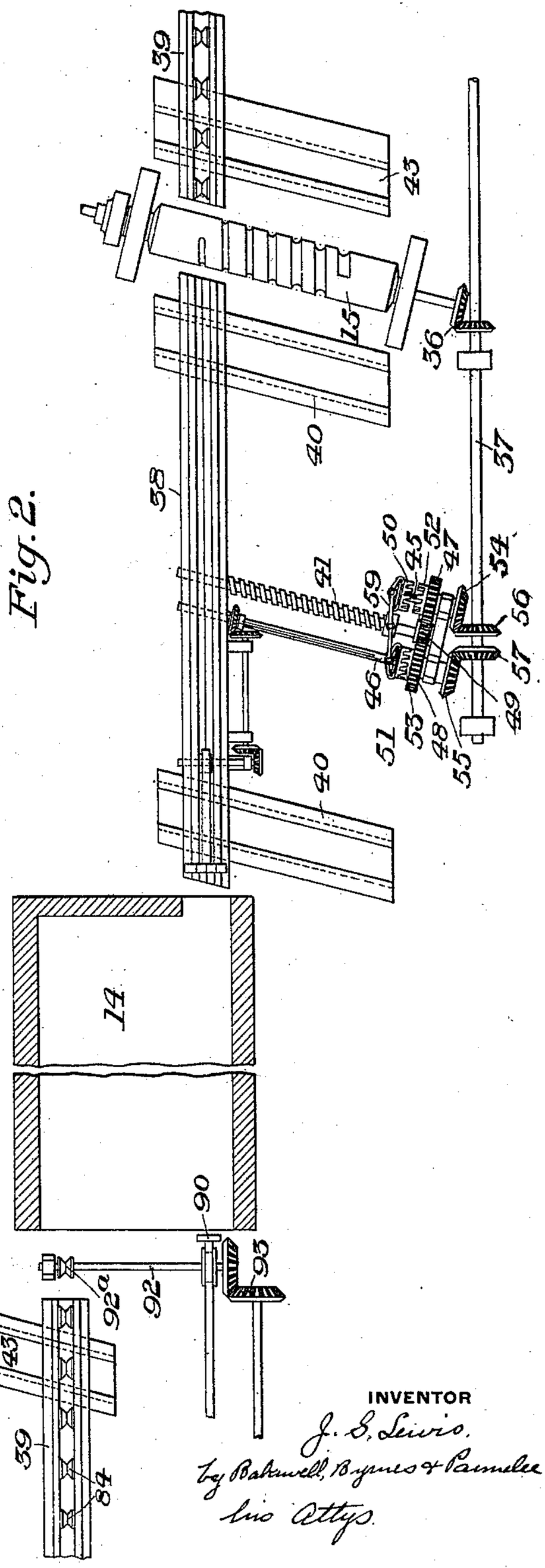


Fig. 2.



WITNESSES

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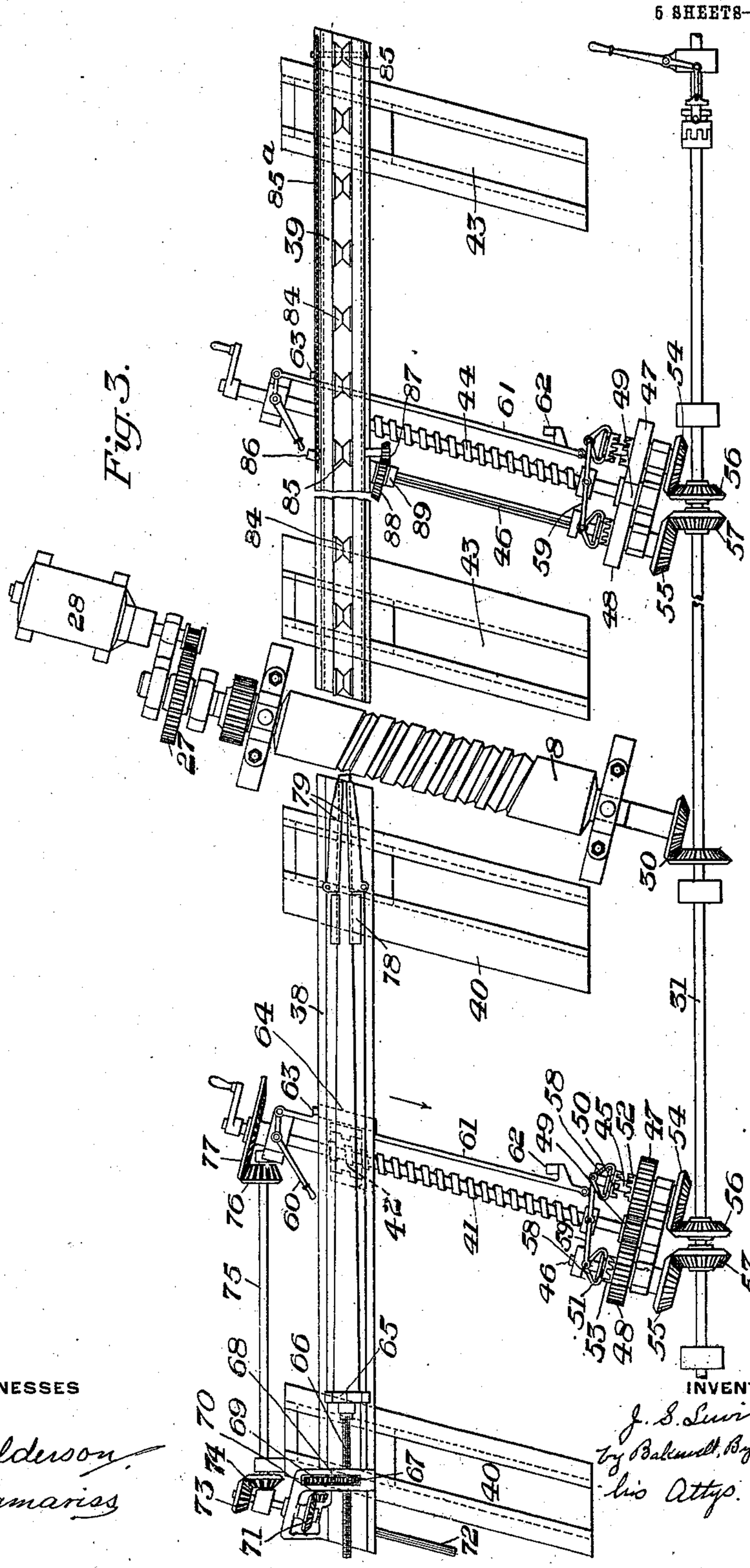
5 SHEETS—SHEET 2.

Fig. 3.



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5 SHEETS—SHEET 3.

Fig. 5.

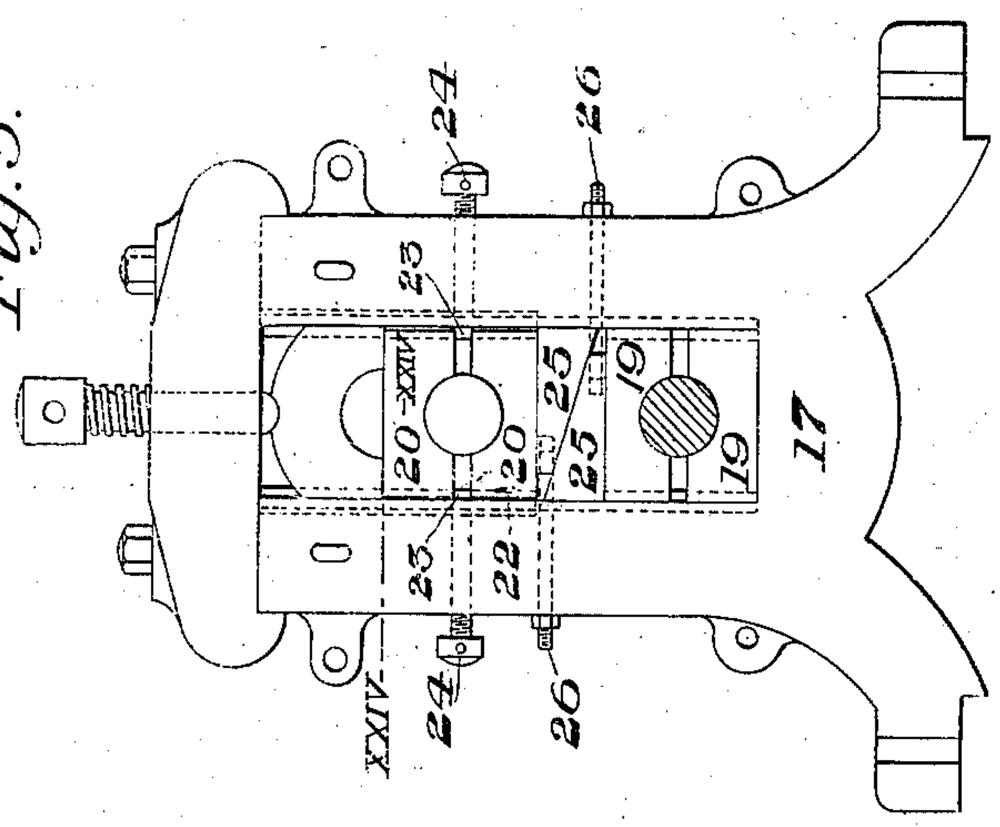


Fig. 4.

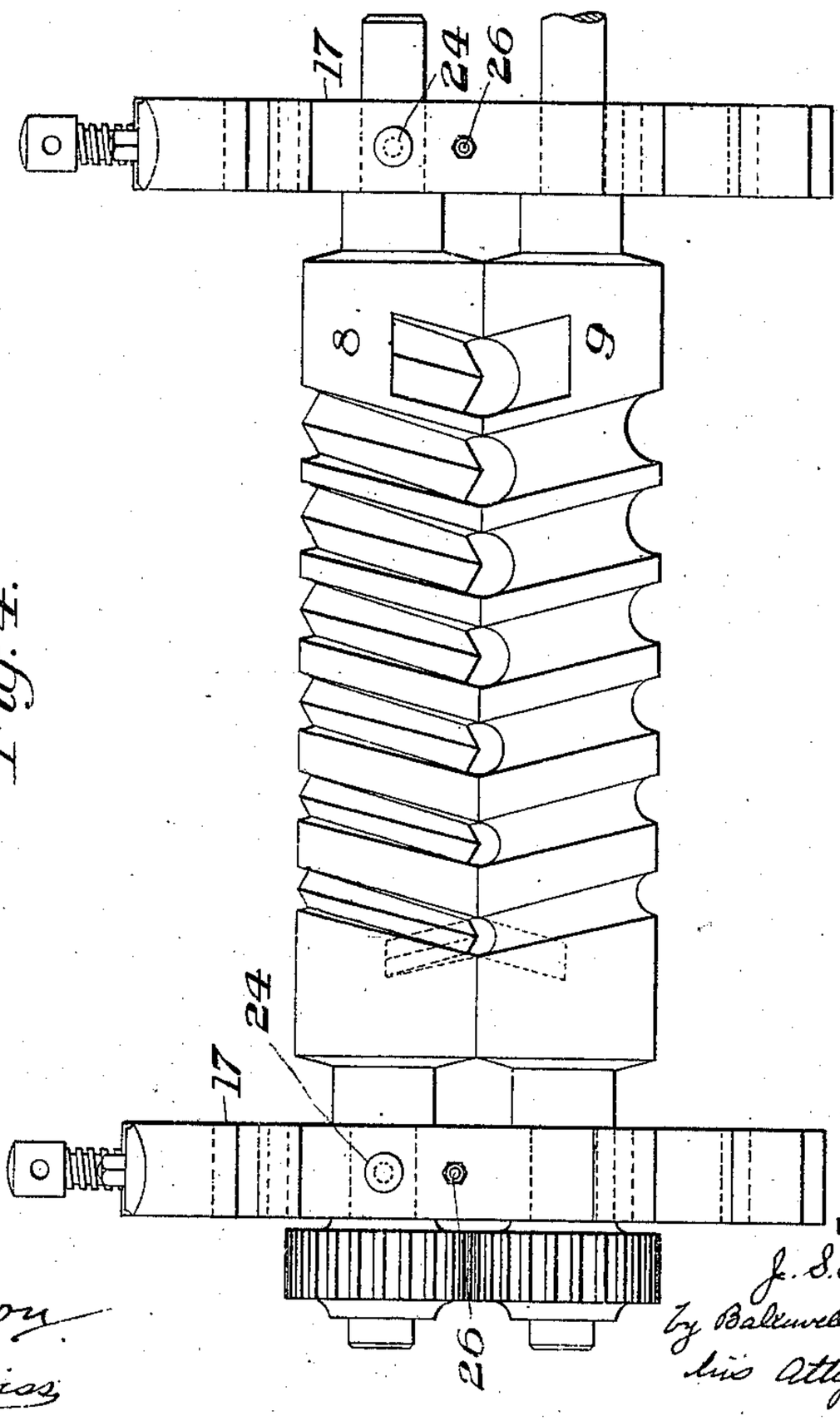
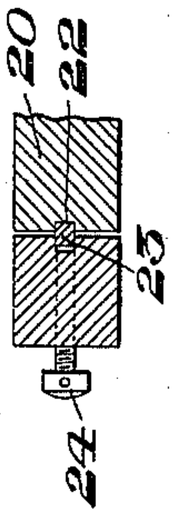


Fig. 24.



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5 SHEETS—SHEET 4.

Fig. 8.

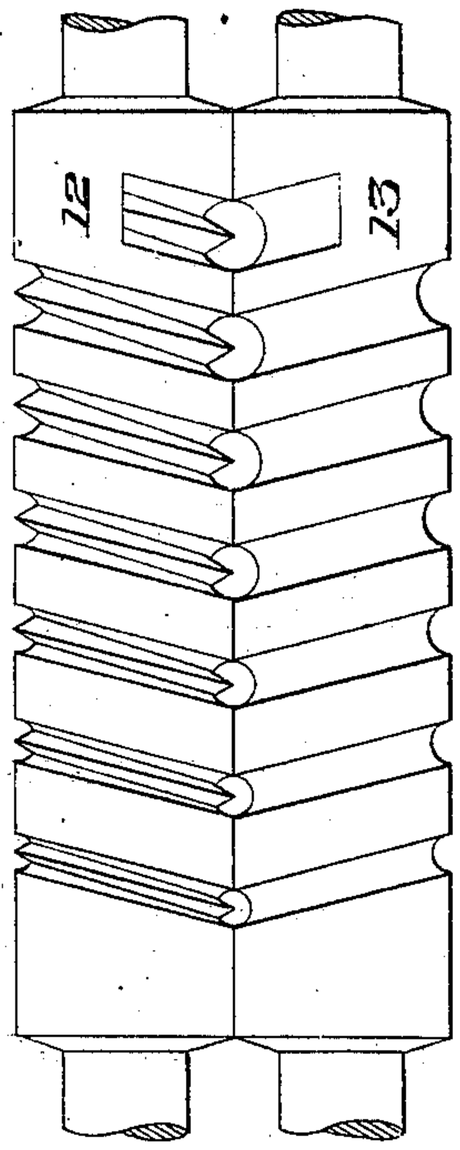

Fig. 9.

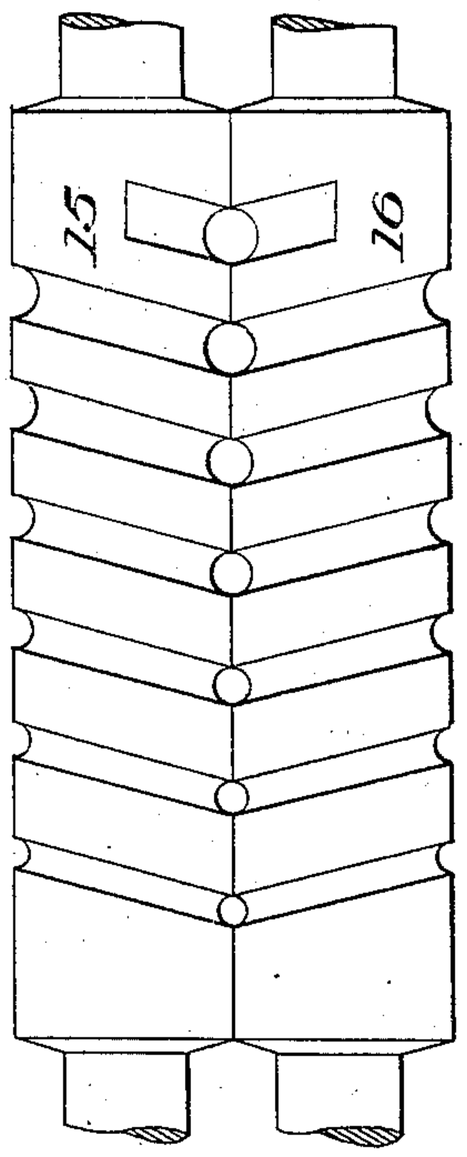

Fig. 15.

Fig. 13.

Fig. 14.

Fig. 11.

Fig. 12.

Fig. 6.

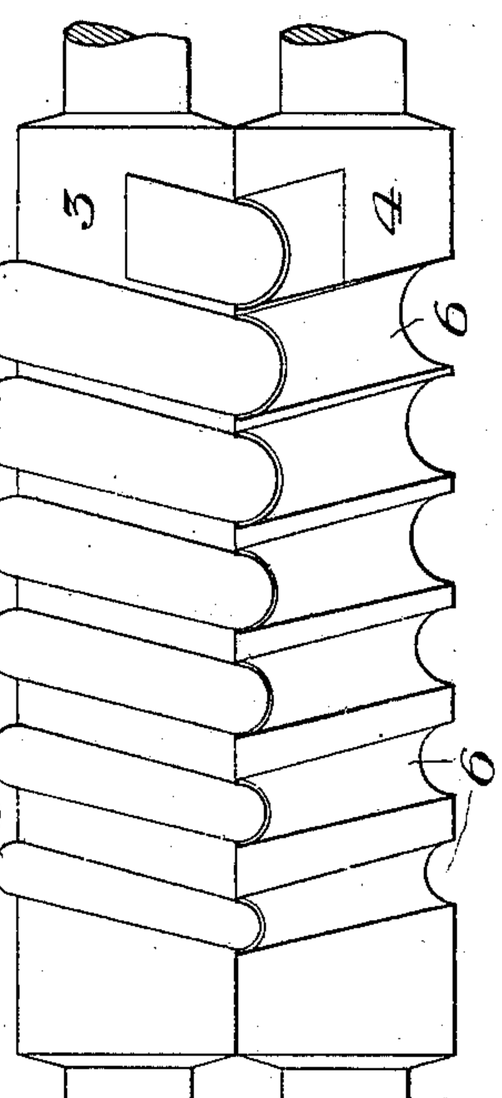

Fig. 7.

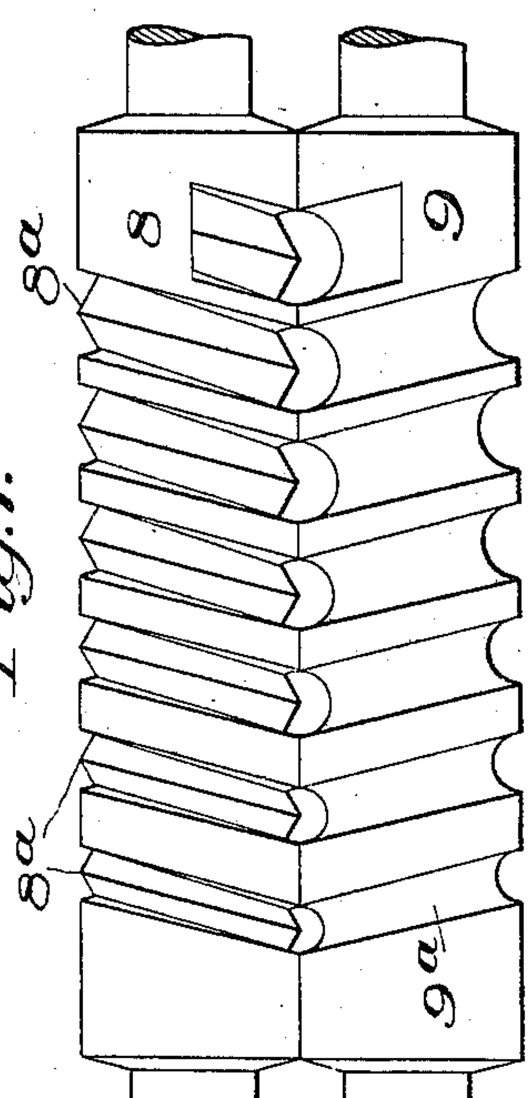

Fig. 10.

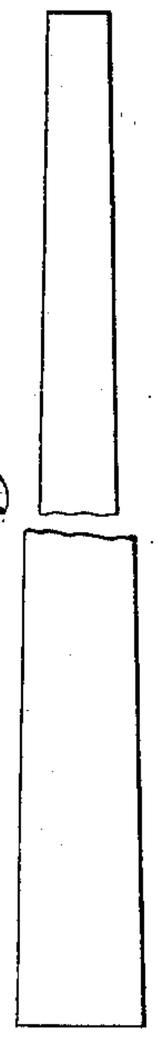

Fig. 16.

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989,508. **Patented Apr. 11, 1911.**

5 SHEETS—SHEET 5.

Fig. 20.

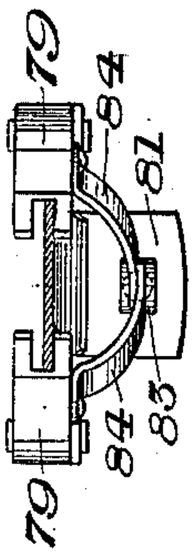


Fig. 21

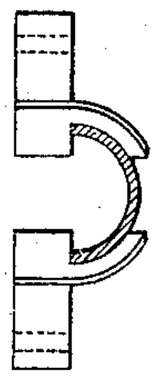


Fig. 22.

Fig. 23.

XIX

Fig. 17.

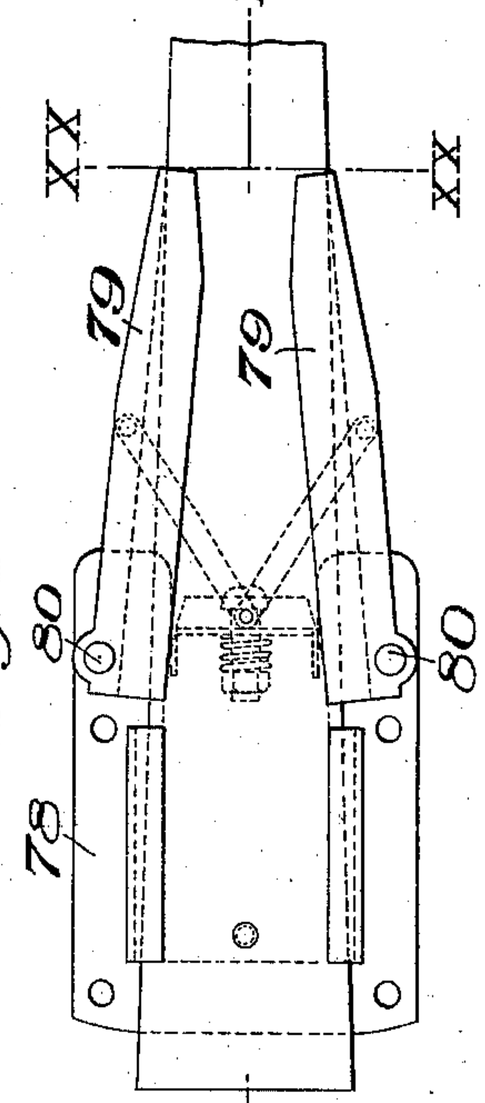


Fig. 18.

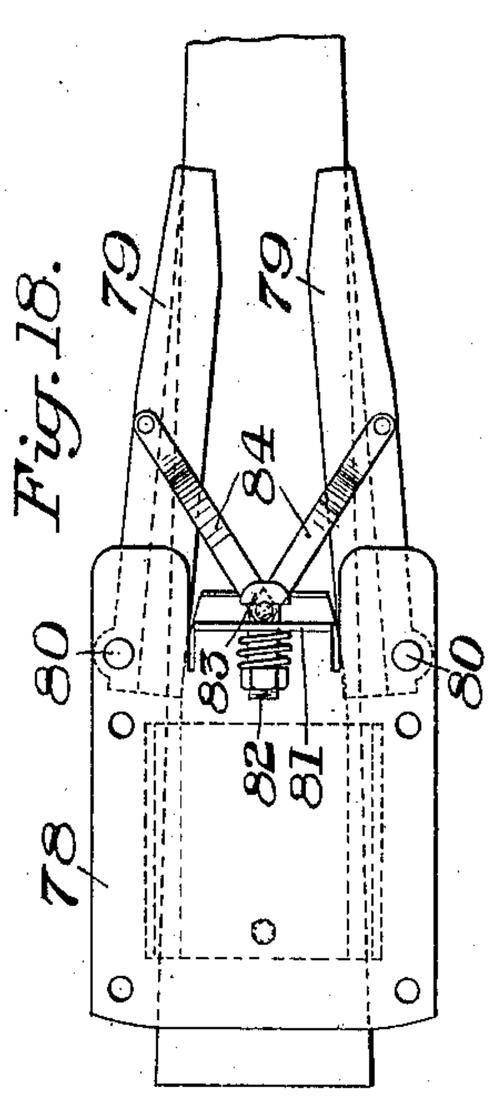
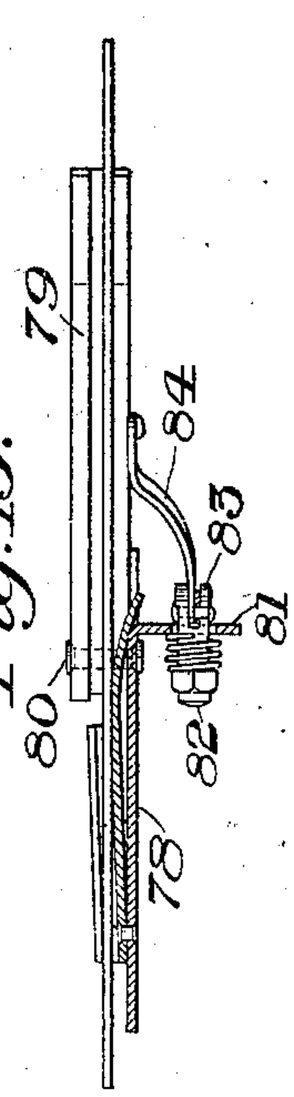


Fig. 19.



XIX

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UNITED STATES PATENT OFFICE.

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APPARATUS FOR ROLLING TAPERED TUBES.

989,508. Specification of Letters Patent. Patented Apr. 11, 1911.

Application filed August 13, 1909. Serial No. 512,664.

To all whom it may concern:

Be it known that I, JAMES S. LEWIS, of McKeesport, Allegheny county, Pennsylvania, have invented a new and useful Improvement in Apparatus for Rolling Tapered Tubes, of which the following is a full, clear, and exact description, reference being had to the accompanying drawings, forming part of this specification, in which—

Figure 1 is a plan view showing diagrammatically one form of my improved apparatus; Fig. 2 is a plan view of the finishing portion of the apparatus with the reheating furnace in section; Fig. 3 is a plan view of the rolls for the second pass and the driving connections; Fig. 4 is a front view of the second stand of rolls; Fig. 5 is an end view of the housing for the rolls; Figs. 6, 7, 8 and 9 are side elevations of the rolls of the various passes; Figs. 10 and 11 are respectively plan and end views of the blank from which the tube is formed; Figs. 12, 13, 14 and 15 are respectively end views of the tube after passing through the rolls shown in Figs. 6, 7, 8 and 9; Fig. 16 is a plan view of a finished tube; Fig. 17 is a detail plan view of the guide for guiding the blank into the first stand of rolls; Fig. 18 is an inverted plan view of the same; Fig. 19 is a longitudinal section on the line XIX—XIX of Fig. 17; Fig. 20 is an end view of the same, showing the blank in section as on the line XX—XX of Fig. 17; Figs. 21, 22 and 23, respectively, are similar views of the device for feeding the blanks to the second, third and fourth passes; and Fig. 24 is a sectional view on the line XXIV—XXIV of Fig. 5.

My invention has relation to the manufacture of butt-welded tubes and other hollow shapes from metal plates, and is designed to provide a simple and efficient apparatus for making such tubes or shapes from tapered plates.

The precise nature of my invention will be best understood by reference to the accompanying drawings, which will now be described, it being premised, however, that various changes and modifications may be made in the construction and arrangement of the several parts by those skilled in the art, without departing from the spirit and scope of my invention.

In making a tapered tube, in accordance with my invention, I first shear elongated tapered blanks of the form shown in Fig. 10, each of which is adapted to the formation of a tapered tube. These blanks are heated in any suitable furnace, and are then fed to a pair of rolls 3 and 4. The roll 3 is provided with a continuous helical rib 5, which fits a correspondingly helical groove or pass 6 in the roll 4, as clearly shown in Fig. 6. This rib and groove are of gradually decreasing size from one end to the other, corresponding to the taper to be formed in the tube. By means of this pair of rolls the blank is shaped to approximately a semicircular form, shown in Fig. 12. This blank is then carried by a suitable conveyer hereinafter described to a second stand of rolls 8 and 9 (see Fig. 7). The lower roll 9 of the second stand is also provided with a helical semicircular groove which is slightly smaller in diameter than the groove in the roll 4. The upper roll of this stand is also provided with a semicircular groove of the same diameter, and its central portion is provided with an angular helical rib 8^a. In passing through this stand of rolls, the complete outer surface of the blank is in contact with the cylindrical portion of the pass, and the edges *b b* of the blank are in contact with the angular rib 8^a. The contact of these edges with the angular rib 8^a assists in keeping the circular surface of the blank in contact with the curved portion of the pass and overcomes all tendency to buckle and thereby forms a blank having a perfect cylindrical surface. The blank is then transferred to a third stand of rolls, 12 and 13, which are similar to the rolls 8 and 9, except that the diameter of the pass is reduced so that the blank in passing therethrough is still further closed to the shape approximately indicated by Fig. 14. This blank is now transferred to a reheating furnace 14, and from said furnace is transferred to a fourth and final stand of rolls 15 and 16. These rolls 15 and 16 are formed with complementary helical grooves, which close the blank into the form shown in Fig. 15, and the butt-welding of these tubes is effected by the action of the roll faces. The finished article is received from the final stand of the rolls upon any suitable conveyer.

The operation of forming a straight tube is the same except that a blank of equal

width at both ends is employed and the passes of the several stands of rolls are of the same diameters throughout their length.

The rolls of each stand are supported in the housings 17. The lower roll is mounted between the split bearing blocks 19, which are provided with a key-groove to slide on a spline or rib secured to the side of the housings. The upper roll is supported in the split bearing blocks 20, which are provided with a groove 22 on each side thereof. Mounted in each of these grooves in the housing, is a spline 23 and extending through the uprights of the housing and in alinement with a spline 23 on each side is an adjusting screw 24, by which the upper roll can be alined with the lower roll. Mounted between the bearing blocks for the upper and lower rolls and between the uprights of the housings are tapered blocks 25, each of which is provided with an integral screw 26, which extends through the uprights of the housing. These screws are for adjusting the blocks 25, so that the upper roll may be raised or lowered.

By means of the adjustments just described, the upper roll can very readily be raised or lowered at either end, and either end of the upper roll can also be adjusted laterally so that it will be in perfect alinement with the lower roll.

In the construction shown, the rolls and the feed mechanism for the blank are driven in the following manner: The second stand of rolls containing the rolls 8 and 9 is positively connected by means of the gearing 27 with a motor 28. The end of one of these rolls is connected by means of bevel gearing 30 with a driving shaft 31. The first and third stand of rolls are driven from this driving shaft by the respective gearings 32 and 33.

The last or finishing stand of rolls beyond the furnace 14, is driven by means of a motor 34, through the intermediate gearing 35, between the rolls and the motor. The opposite end of one of the rolls of this stand is connected by means of the bevel gearing 36, with a longitudinal shaft 37 for the purpose hereinafter described.

Each stand of rolls is provided with a transversely movable supporting trough 38, for the blank, and it is also provided with a transversely movable receiving trough 39.

The detailed construction and connections for the supporting device for each set of rolls is precisely the same, and the set for the second stand of rolls is clearly shown in Fig. 3. In this figure, the supporting trough 38 is supported in guides 40, at each end thereof, and parallel with the axes of the rolls. Mounted centrally between these guides below the trough 38, and parallel with the guides is a screw shaft 41, which is provided with a nut 42, which is in engagement with lugs on the trough 38, or may be secured thereto in any manner. When this screw shaft 41 is rotated to the right, the trough 38 is moved across the face of the rolls in the direction of the arrow; and when the screw shaft is rotated in the reverse direction, the trough is moved in the reverse direction across the face of the rolls. This trough 38 is so placed that it will be in operative alinement at all times with the pass between the two rolls. The receiving trough is also supported on guides 43 which are similar to the guides 40 of the delivery trough and it is also provided with a screw shaft 44 to move the receiving trough in the same manner, as the delivery trough is moved. The delivery and receiving troughs are in alinement with each other and in line with the pass between the rolls. These screw shafts are driven from the main shaft 31 in the following manner. Mounted in a portion of the frame of the machine are countershafts 45 and 46. Loosely mounted on the shafts 45 and 46 are spur gears 47 and 48, respectively. Mounted on the screw shaft 41 is a pinion 49, and splined to the shafts 45 and 46 are movable clutch members 50 and 51, respectively. Mounted on or integral with the gear wheels 47 and 48, are the respective clutch members 52 and 53. Mounted on the ends of the shafts 45 and 46 are the bevel gears 54 and 55, respectively, which mesh with the respective gears 56 and 57, secured to the driving shaft 31. These counter-shafts 45 and 46 are positively rotated in reverse directions by means of their bevel gear connections with the driving shaft 31, and when the clutch member 51 is in engagement with the clutch member 53, on the gear 48, the screw shaft 41 will be rotated in one direction; when the last mentioned clutch members are disengaged, and when the clutch members 50 and 52 are in engagement, the screw shaft will be rotated in the reverse direction.

Loosely mounted in an annular groove in each of the clutch members 50 and 51 is a fork 58, and pivotally connected to each of these forks is a lever 59, which is pivotally connected at its center to the bearing of the screw shaft 41 or to any stationary portion of the apparatus. Pivotally connected to a stationary portion of the apparatus or to the bearing for the opposite end of the screw shaft 41 is a hand lever 60. Pivotally connected to one end of this hand lever and to the lever 59 is a link 61, provided with lugs 62 and 63. Connected to the end portion of the supporting and feeding trough 38 is a lug 64, which is in line with the lugs 62 and 63 on the link 61. When the feeding trough 38 moves across the face of the roll in the direction of the arrow, the lug 64 will strike the lug 62, and rock the lever 59, to reverse the clutches, the screw shaft 41 will then be

rotated in the reverse direction to move the feeding and supporting trough 38 in the reverse direction; and when the lug 64 strikes the lug 63, the clutch is again reversed to the position shown in Fig. 3.

As the driving mechanism for the feeding trough of each stand of rolls is the same, I have merely described the connections for the feeding trough for one stand of rolls.

As the operating mechanism for moving the receiving trough 39 across the face of the roll is the same as the mechanism for moving the feeding trough 38, it is unnecessary to describe the mechanism for operating the screw shaft 44.

In the rear end of the delivery trough 38 is a positive feeding member 65, which is mounted so as to slide longitudinally in the feeding trough 38. This feeding member 65 is loosely mounted on the end of a screw shaft 66 which passes through a pinion 67, provided with a screw-threaded hub. This pinion is mounted so as to be rotated within a bracket 68 formed integral with or secured to the end of the feeding trough 38. Journaled within this bracket 68 and in mesh with the pinion 67 is a gear 69, and mounted on the end of the hub of the gear 69 is a gear 70, which meshes with a miter gear 71, rotatably mounted between the ends of the bracket 68, and within which it is held from longitudinal movement. This bevel gear 71 is splined upon a shaft 72, and as the feeding trough 38 moves across the face of the rolls, the miter gear 71 moves along the shaft 72, but is always in rotating engagement therewith through the medium of the spline connection. On the end of this shaft 72 is a bevel gear 73, which is in mesh with a bevel gear 74 on the end of the shaft 75. Secured to the opposite end of this shaft 75 is the bevel gear 76, which meshes with a bevel gear 77 on the end of the screw shaft 41. When the screw shaft 41 is rotated in the proper direction to move the feeding trough in the direction of the arrow, the feeding member is moved toward the rolls to start the blank into the pass, and as the feeding trough is moved in the opposite direction, the feeding member 65 is withdrawn toward the rear end of the feeding trough.

The end of the feeding trough 38, adjacent to the rolls is provided with a self-adjusting guide 78, which is illustrated in Figs. 17 to 23, inclusive. This guide consists of a base plate which is secured to the trough 38. 79 are grooved guides which are pivoted to the base plate at 80. Extending downwardly from the front end of the base plate is a projection 81, which is provided with an orifice in which is mounted a spring-pressed bolt 82, capable of longitudinal movement therein. This bolt is provided with a slotted head 83, to receive one end of the links 84. The other end of each of these links is pivotally connected to one of the grooved guides 79. The spring bolt 82, through the medium of its connections with the slotted guides, steadies and holds the blank centrally with relation to the pass between the rolls.

Figs. 17 to 20, inclusive, illustrate the guide for the first pass, or the pass which receives the sheared blanks. The space between the grooved guides 79 at their heel or pivoted end must be sufficient to receive the greatest width of the blank, and the front ends must be capable of being closed sufficiently by means of the spring bolt to contact with the narrow end of the sheared blank.

Figs. 21, 22 and 23 are views similar to Fig. 20, and illustrate members 79 for engaging the blank to be fed to the second, third and fourth passes, respectively.

All of the rolls and the feeding mechanism may be driven by a common shaft, or each roll and its feeding mechanism may be driven independently. The first three stands of rolls and their feeding mechanism may be driven from a common shaft, and the shaft for the last stand may be geared thereto by suitable gearing. In this case, I have shown the first three sets of rolls and their feeding mechanism driven from the shaft 31, and the feeding mechanism for the last stand of rolls is driven from the shaft 31.

The operation is as follows: The blank shown in Fig. 10 is heated in a suitable furnace and is then placed in the feed trough 38 in front of the rolls 3 and 4. The feeding member 65 is advanced by means of the screw shaft 66, which forces the blank through the guide 78 into the first stand of rolls and it is received in the first receiving trough 39. Both the delivery trough 38 and the receiving trough 39 are moved across the face of the rolls in the direction of the arrows indicated in Fig. 3, at the same rate of speed as the pitch of the pass in these rolls. As soon as the blank has passed through these rolls, it is advanced by means of the positively operated grooved rolls 85 in the trough 39 to the next feed trough 38, in front of the second stand of rolls, and the operation is repeated. The operation is again repeated for the third stand of rolls and as soon as the blank has passed through the third stand of rolls, the positively operated grooved rollers 85 feed the blank to a similar positively operated roller 92^a, which will transfer the blank to the furnace 14. After the blank has been properly reheated in the furnace, it is pushed out of the opposite end thereof by means of the pusher 90, which is advanced by a rack bar 91, which is operated by the transverse shaft 92, connected by means of bevel gearing 93 of the main driving shaft 31. This pushing device 90 transfers the blank into the feeding trough 38 of the last stand of rolls,

through which it is fed by the feeding member in this trough through the last stand of rolls to the receiving trough beyond the rolls, and from whence it may be fed to any proper take-off mechanism.

The advantages of my invention result from the provision of apparatus for rolling butt-welded tubes, in which the blank is first rolled to approximately a semicircular form, after which it is further closed to a circular form by passing it through a stand of rolls having a pass which contacts with the outer surface of the blank and with the edges to be welded, after which it is passed through the heating furnace to reheat the blank, the reheated blank being then passed through a pair of finishing rolls to close and butt-weld the edges of the blank. Also, from the provision of positively operated transversely movable supports on each side of each stand of rolls, arranged to move at the same rate of speed as the pitch of the pass between the rolls. Further, from the provision of means for positively advancing the blank into the rolls and also from the provision of adjustable means for guiding the tapered blank into the rolls.

I claim:

1. In apparatus for forming tubes, a stand of rolls having continuous helical male and female surfaces for bending the blank into approximately semicircular form, a second stand of rolls having a continuous helical pass arranged to engage the outer surface and the edge faces of the longitudinal edges of said blank to further bend it into circular form, and a finishing stand of rolls to bend the blank into circular form and bring its edge faces into contact with each other; substantially as described.

2. In apparatus for forming tubes, a stand of rolls having continuous helical male and female surfaces for bending the blank into approximately semicircular form, a plurality of stands of rolls having a continuous helical pass arranged to engage the outer surface and the edge faces of the longitudinal edges of said blank to further bend it into circular form, and a finishing stand of rolls to bend the blank into circular form and bring its edge faces into contact with each other; substantially as described.

3. In apparatus for forming tapered tubes, a stand of rolls having male and female surfaces for bending the blank into approximately semicircular form, a second stand of rolls having a continuous helical pass arranged to engage the outer surface and the edge faces of the longitudinal edges of said blank to further bend it into circular form, a finishing stand of rolls to bend the blank into circular form and bring its edge faces into contact with each other; substantially as described.

4. In apparatus for forming tapered tubes, a stand of rolls having male and female surfaces for bending the blank into approximately semicircular form, a second stand of rolls having a continuous helical pass arranged to engage the outer surface and the edge faces of the longitudinal edges of said blank to further bend it into circular form, a finishing stand of rolls to bend the blank into circular form and bring its edge faces into contact with each other, and means to transfer the blanks from one stand of rolls to the next stand of rolls; substantially as described.

5. In apparatus for forming tapered tubes, a stand of rolls having continuous helical male and female surfaces for bending the blank into approximately semicircular form, a second stand of rolls having a continuous helical pass arranged to engage the outer surface and the longitudinal edges of said blank to further bend it into circular form, and a transversely movable support for the blank on each side of each stand of rolls, substantially as described.

6. In apparatus for forming tapered tubes, a stand of rolls having a continuous helical male and female surface, for bending the blank into approximately semicircular form, a second stand of rolls having a continuous helical pass arranged to engage the outer surface and the longitudinal edges of said blank to further bend it into circular form, a transversely movable support for the blank on each side of each stand of rolls, and means to move the supports in line with the blank during its horizontal movement across the rolls, substantially as described.

7. In apparatus for forming tapered tubes, a stand of rolls having a continuous helical male and female surface for bending the blank into approximately semicircular form, a second stand of rolls having a continuous helical pass arranged to engage the outer surface and the longitudinal edges of said blank to further bend it into circular form, and a transversely movable support for the blank on each side of each stand of rolls, means to move the supports in line with the blank during its horizontal movement across the rolls, and means for automatically reversing the movement of the supports at both ends of the rolls, substantially as described.

8. In apparatus for forming tapered tubes, a stand of rolls having continuous coacting helical male and female surfaces for bending said blank into approximately semicircular form, a second stand of rolls having a continuous helical pass arranged to engage the outer surface and the longitudinal edges of said blank to further bend it into circular form, a transversely movable support for the blank on each side of each stand of rolls, and an adjustable guide secured to the delivery support to guide the

blank into the rolls, substantially as described.

9. In apparatus for forming tapered tubes, a stand of rolls having continuous coacting helical male and female surfaces for bending the blank into approximately semicircular form, a second stand of rolls having a continuous helical pass arranged to engage the outer surface and the longitudinal edges of said blank to further bend it into circular form, transversely movable supports for the blank, an adjustable guide secured to the delivery support to guide the blank into the rolls, and positively-actuated means for pushing the blank into the rolls, substantially as described.

10. In apparatus for forming tapered tubes, a stand of rolls having male and female surfaces for bending the blank into approximately semicircular form, a second stand of rolls having a pass arranged to engage the outer surface of said blank to further bend into circular form, and an adjustable guide arranged to deliver the blank centrally between the rolls of each pass; substantially as described.

11. In apparatus for forming tapered tubes, a stand of rolls having male and female surfaces for bending the blank into approximately semicircular form, a second stand of rolls having a pass arranged to engage the outer surface of said blank to further bend into circular form, an adjustable guide arranged to deliver the blank centrally between the rolls of each pass, and positively actuated means for pushing the blank into the rolls; substantially as described.

12. In apparatus for forming tapered tubes, a stand of rolls having continuous co-acting helical male and female surfaces for bending the blank into approximately semi-circular form, a second stand of rolls having a continuous helical pass arranged to engage the outer surface of said blank to further bend it into circular form, transversely movable supports for the blank on each side of each stand of rolls, and means to move the supports in line with the blank during its horizontal movement across the rolls; substantially as described.

13. In apparatus for forming tapered tubes, a stand of rolls having continuous coacting helical male and female surfaces for bending the blank into approximately semicircular form, a second stand of rolls having a continuous helical pass arranged to engage the outer surface of said blank to further bend it into circular form, transversely movable supports for the blank on each side of each stand of rolls, means to move the supports in line with the blank during its horizontal movement across the rolls, and positively actuated means carried by the support to push the blank into the rolls; substantially as described.

14. In apparatus for forming tapered tubes, a stand of rolls having continuous coacting helical male and female surfaces for bending the blank into approximately semicircular form, a second stand of rolls having a continuous helical pass arranged to engage the outer surface of said blank, to further bend it into circular form, a transversely movable support for the blank on each side of each stand of rolls, means to move the supports in line with the blank during its horizontal movement across the rolls, and means for automatically reversing the movement of the supports at both ends of the rolls; substantially as described.

15. In apparatus for forming tapered tubes, a stand of rolls having continuous coacting helical male and female surfaces for bending the blank into approximately semicircular form, a second stand of rolls having a continuous helical pass arranged to engage the outer surface of said blank to further bend it into circular form, a transversely movable support for the blank on each side of each stand of rolls, and a spring actuated adjustable guide mounted on the support and arranged to guide the blank into the rolls; substantially as described.

16. In apparatus for forming tapered tubes, a stand of rolls having a continuous helical male and female surface for bending the blank into an approximately semi-circular form, a guide having a pair of pivoted arms arranged to guide the blank into rolls, and means to draw the ends of the arms of the guide toward each other; substantially as described.

In testimony whereof, I have hereunto set my hand.

JAMES S. LEWIS.

Witnesses:
JESSE B. HELLER,
H. M. CORWIN.