

Aug. 25, 1942.

C. A. NICHOLS

2,293,846

ELECTRIC WELDER

Filed April 9, 1941

8 Sheets-Sheet 1

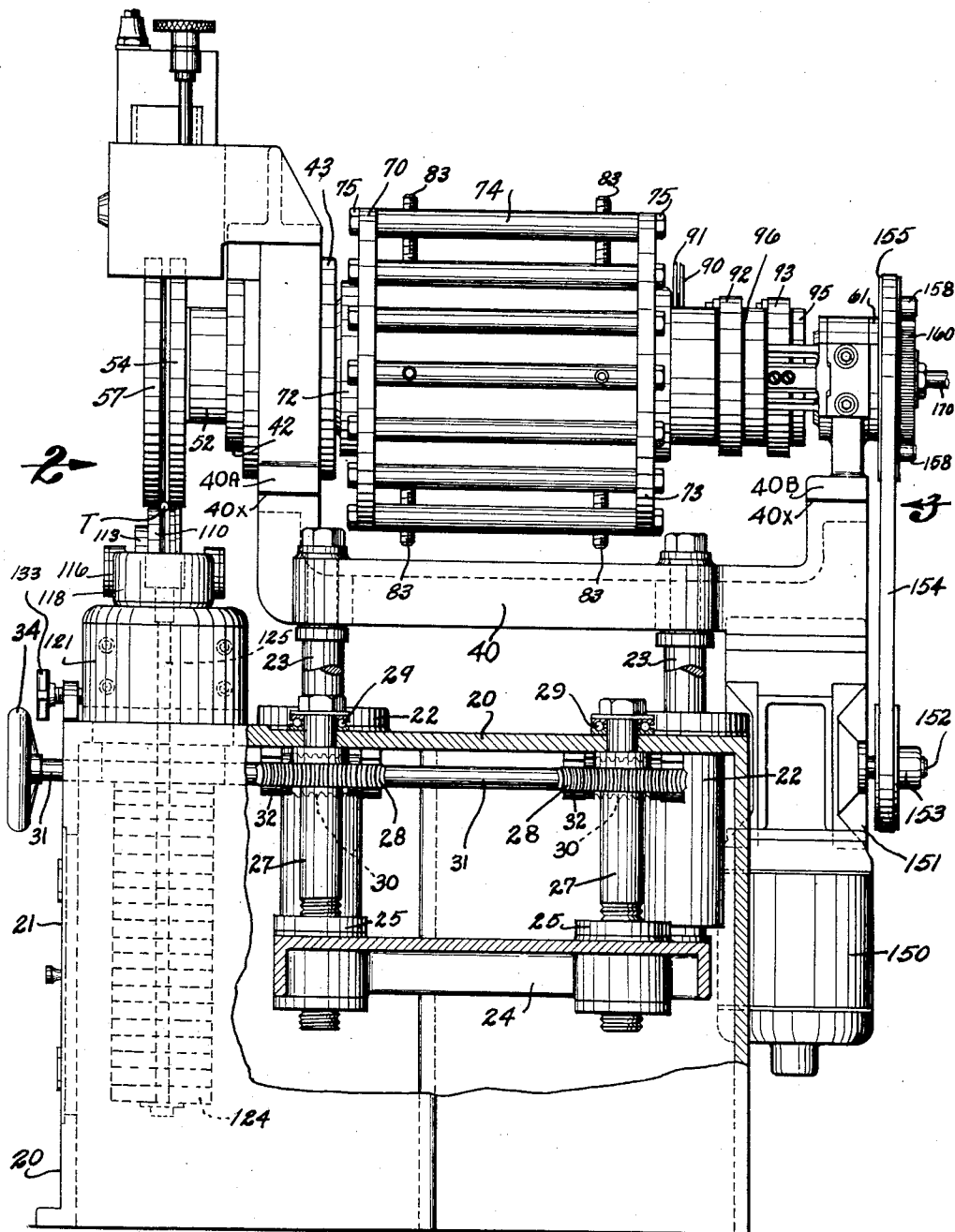


Fig. 1

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8 Sheets-Sheet 2

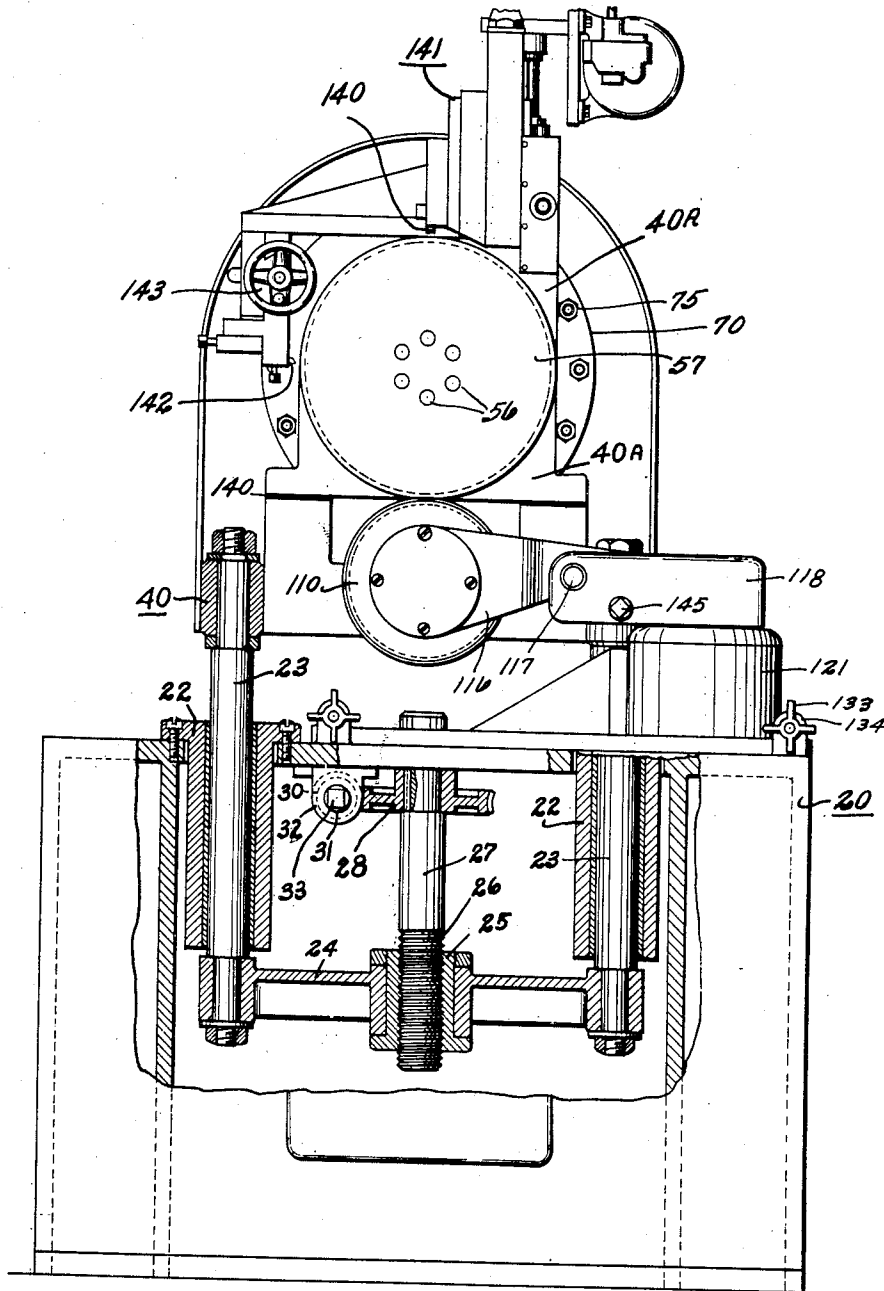


Fig. 2

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8 Sheets-Sheet 3

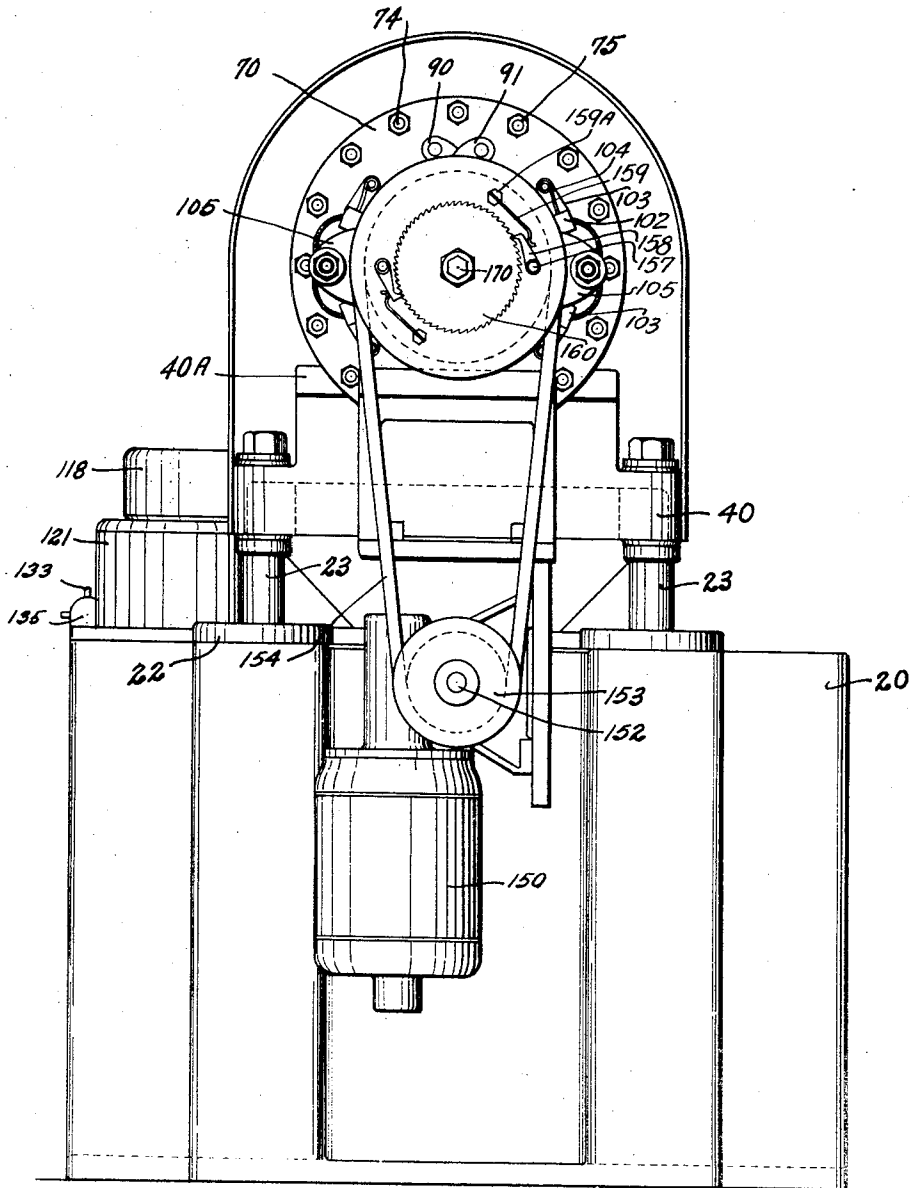


Fig. 3

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8 Sheets-Sheet 4

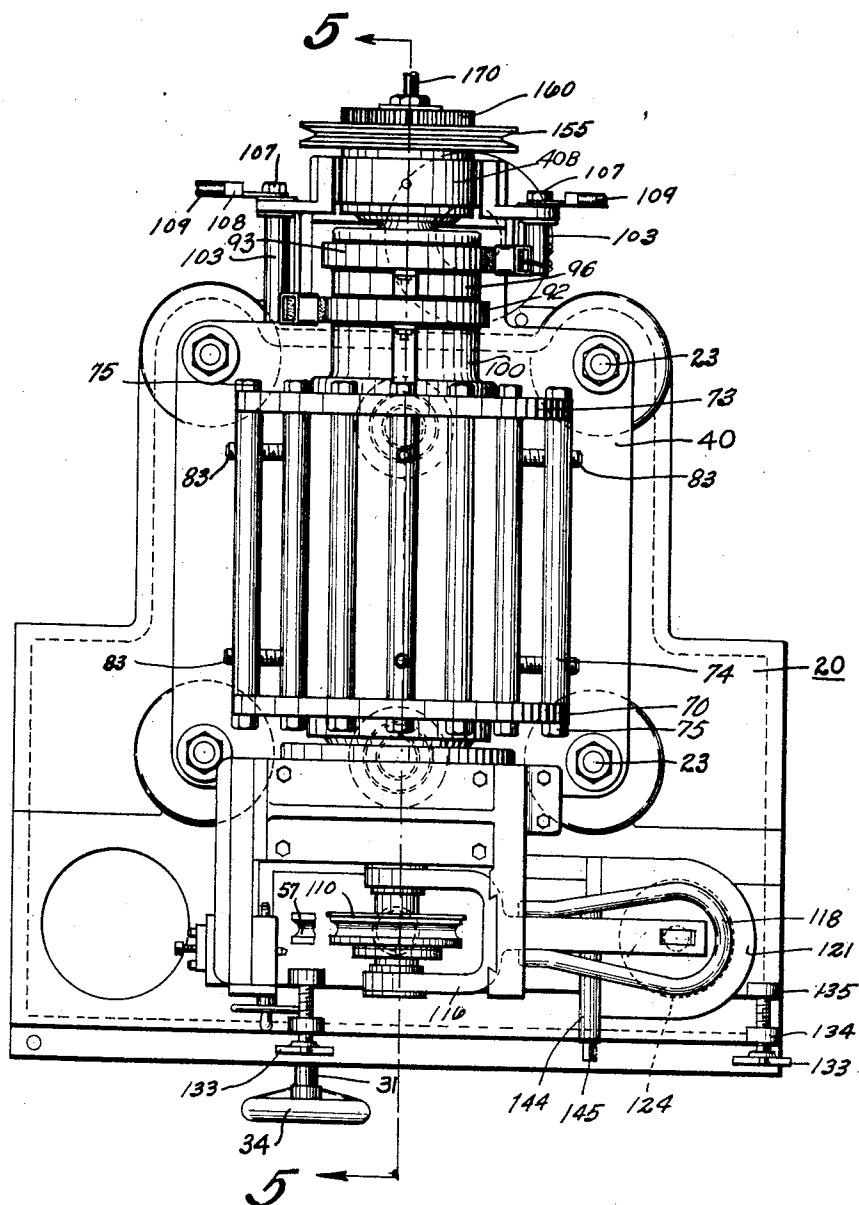


Fig. 4

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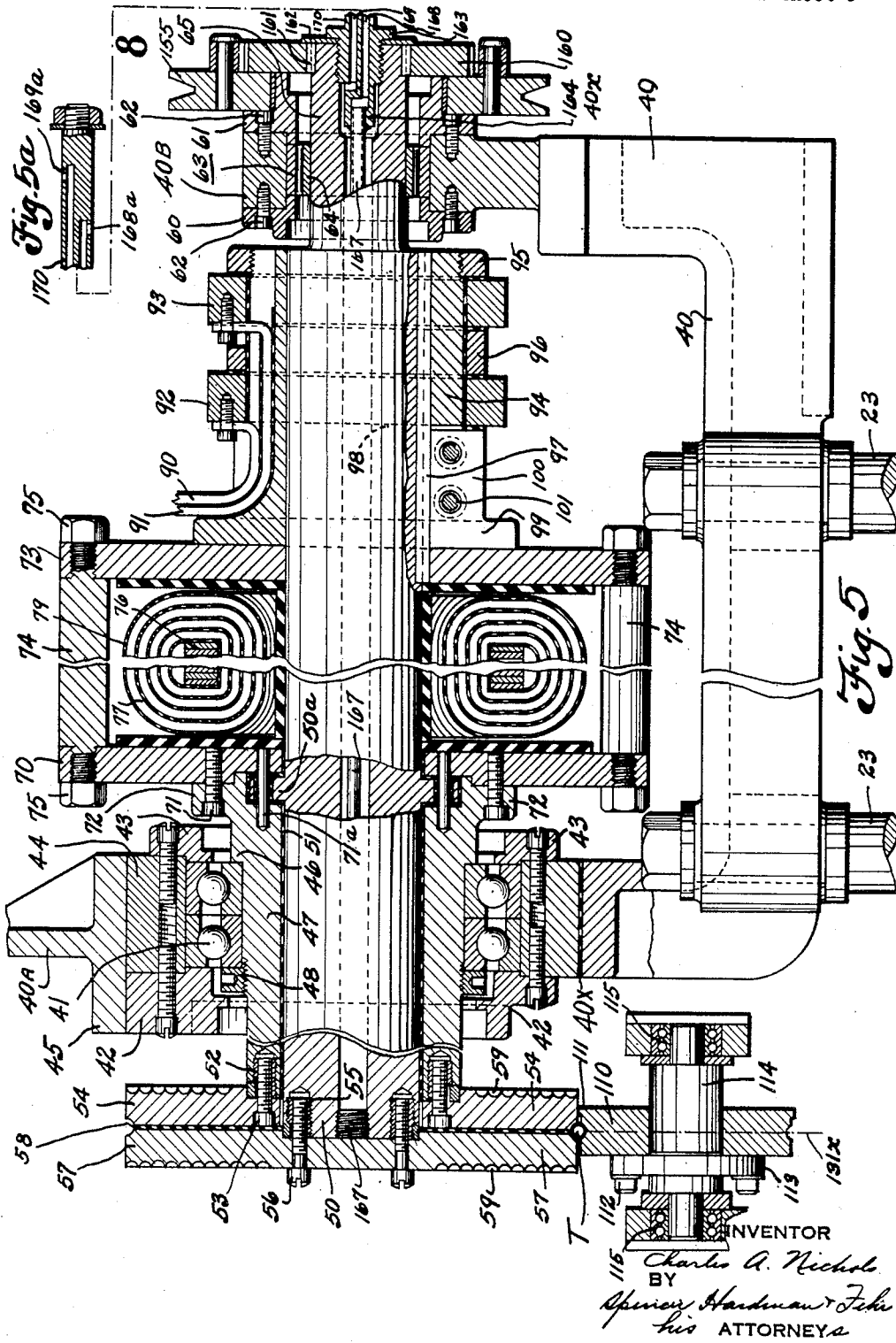
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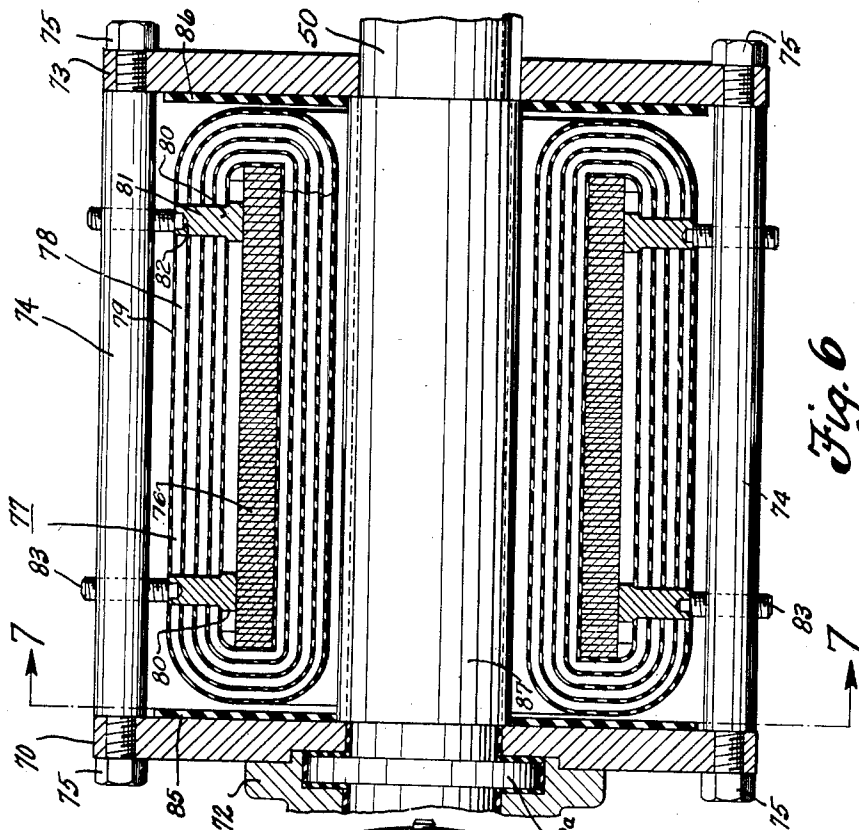


Fig. 6

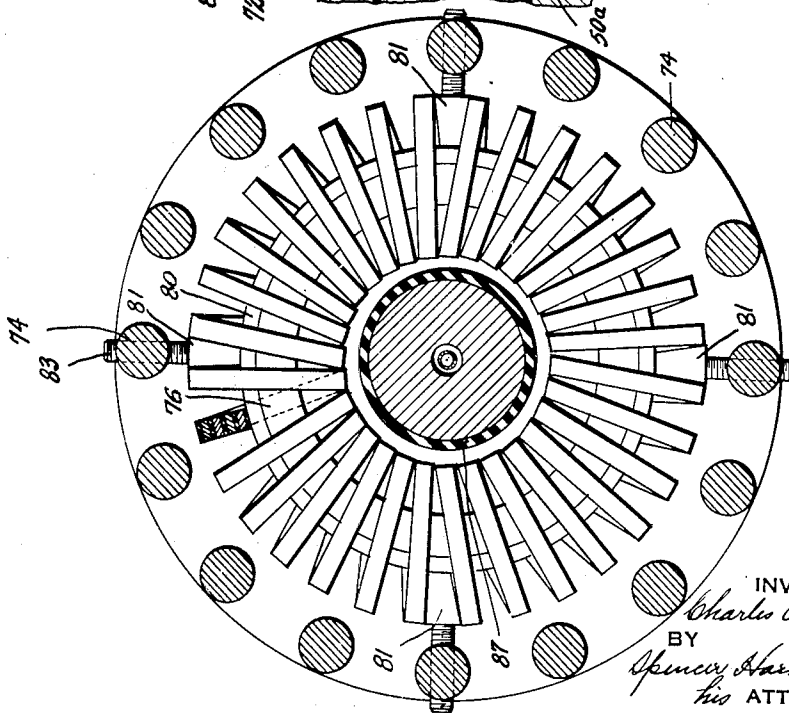


Fig. 7

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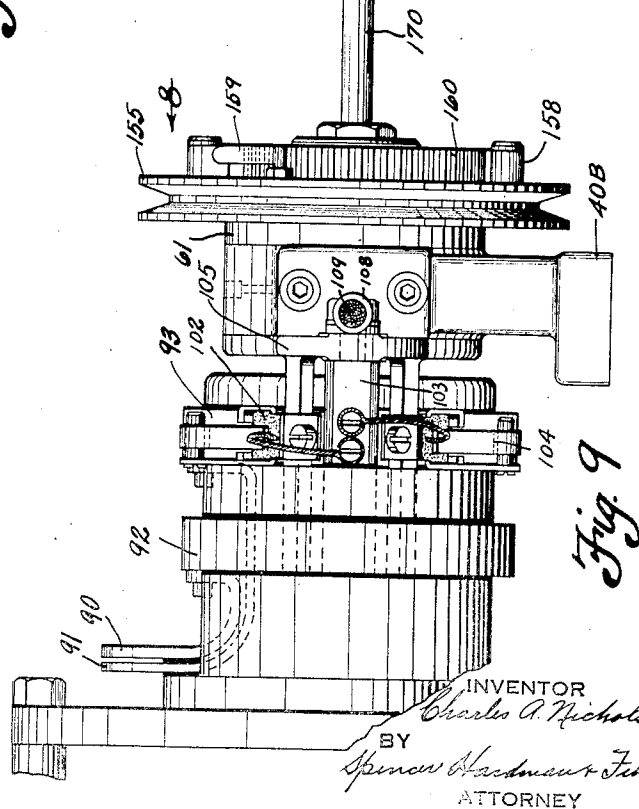
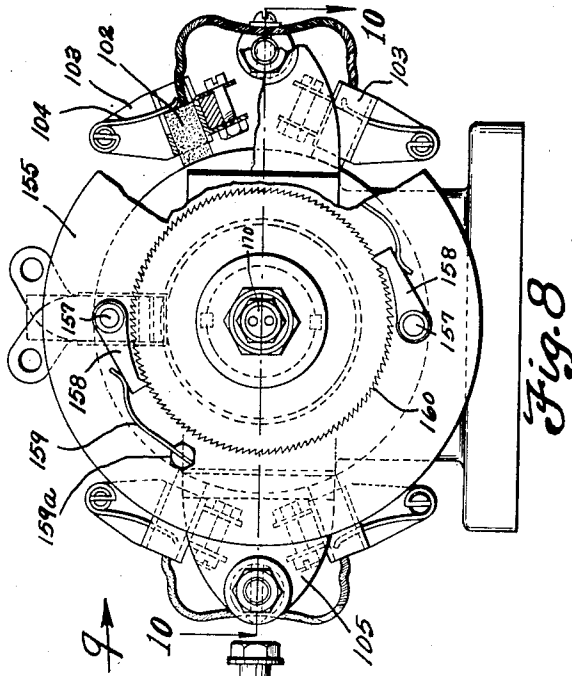
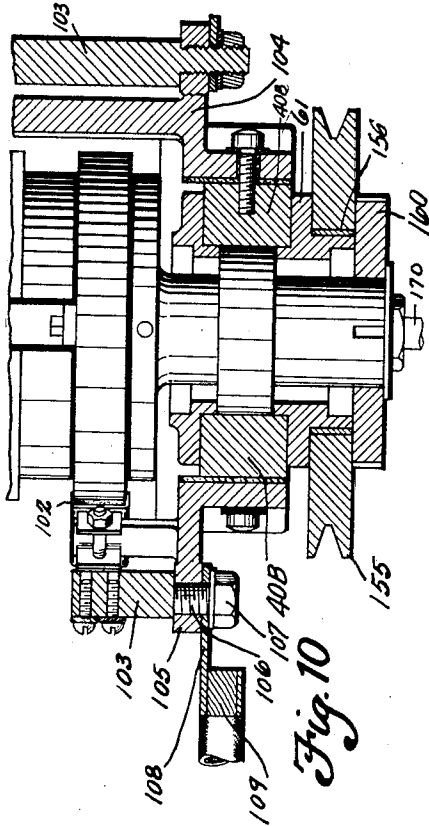
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ELECTRIC WELDER

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8 Sheets-Sheet 7



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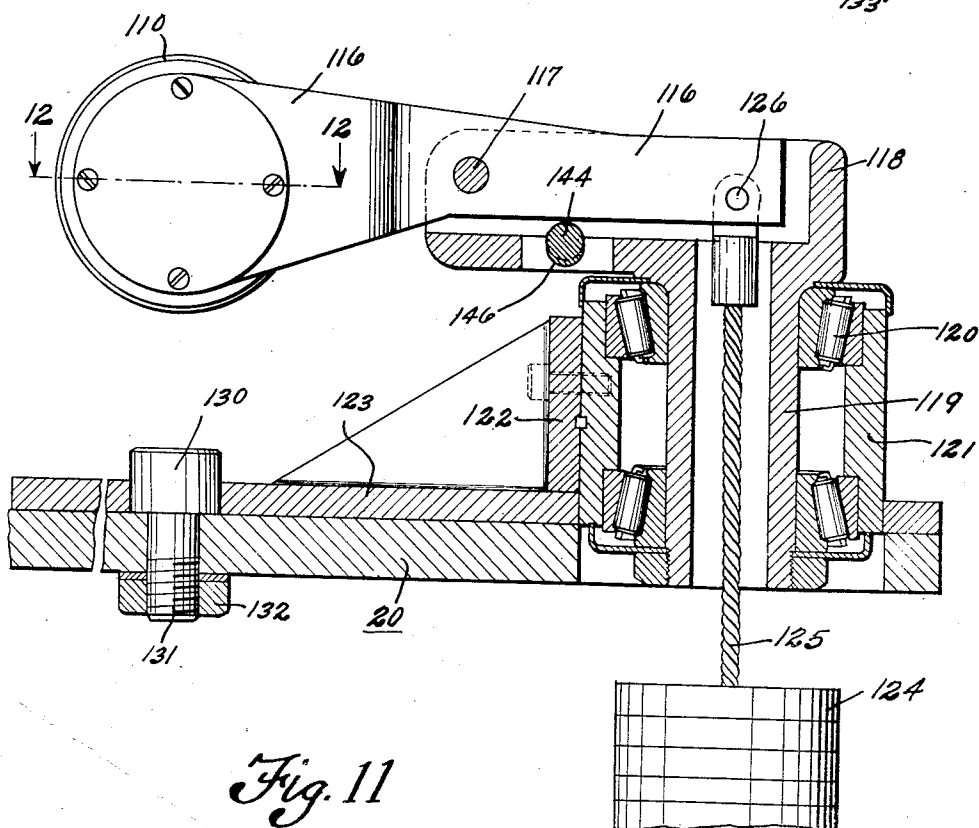
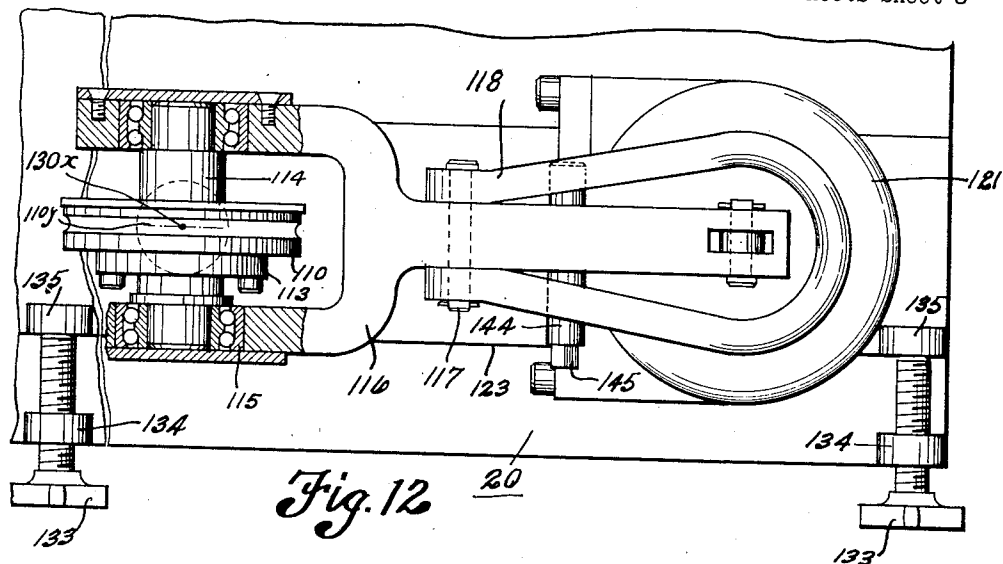
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ELECTRIC WELDER

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8 Sheets-Sheet 8



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UNITED STATES PATENT OFFICE

2,293,846

ELECTRIC WELDER

Charles A. Nichols, Anderson, Ind., assignor to
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corporation of Delaware

Application April 9, 1941, Serial No. 387,565

6 Claims. (Cl. 219—6)

This invention relates to the manufacture of electrically welded steel tubing.

The object of the invention includes the provision of an improved electric welding machine of simple and durable construction which may be manufactured at low cost.

Further objects and advantages of the present invention will be apparent from the following description, reference being had to the accompanying drawings wherein a preferred embodiment of the present invention is clearly shown.

In the drawings:

Fig. 1 is a side elevation partly in section showing a welding machine embodying the present invention;

Fig. 2 is a view taken in the direction of the arrow 2 of Fig. 1, and is partly in section;

Fig. 3 is a view taken in the direction of arrow 3 of Fig. 1;

Fig. 4 is a plan view;

Figs. 5 and 5a provide a fragmentary longitudinal sectional view on the line 5—5 of Fig. 4 and is drawn to a larger scale than Fig. 4;

Fig. 6 is a longitudinal sectional view of the transformer of which a fragmentary sectional view appears in Fig. 5;

Fig. 7 is a sectional view on the line 7—7 of Fig. 6;

Fig. 8 is a view looking in the direction of arrow 8 of Fig. 9;

Fig. 9 is a view in the direction of arrow 9 of Fig. 8;

Fig. 10 is a sectional view on the line 10—10 of Fig. 8;

Fig. 11 is a fragmentary view partly in section showing the front elevation of the pressure roll which appears in a smaller scale in Fig. 2 below the welding roll; and

Fig. 12 is a plan view of the part shown in Fig. 11 and is partly in section, the section being taken on the line 12—12 of Fig. 11.

The apparatus comprises a box-like base 20 of Fig. 1 provided with a door 21 in the left wall thereof. Referring also to Fig. 2, the base 20 supports four tubular bearings 22 for guiding vertically movable rods 23, the lower ends of which are attached to a spider 24, provided with nuts 25 for receiving screws 26 provided by a shaft 27 attached to worm wheels 28 supported by step bearings 29, (Fig. 1) resting upon the top of the base 20. Worm wheels 28 mesh with worms 30 connected with a shaft 31 supported by bearing brackets 32 attached to the underside of the top of the base 20. Shaft 31 has a squared end 33

(Fig. 2) for receiving a handwheel 34 (Fig. 1). By turning the handwheel 34 the rods 23 may be raised or lowered in order to vary the elevation of the welding electrodes to be described.

The rods 23 support a frame 40 insulatingly supporting at its ends bearing brackets 40A and 40B. Micarta insulating plates 40X space the brackets 40A and 40B from frame 40. Bracket 40A supports ball bearings 41 (Fig. 5) which are secured between retainer plates 42 and 43 secured to a ring 44 which is fixed to the annular bearing boss 45 integral with the bracket 40A. The inner races of the ball bearings 40 are clamped together and are confined between a shoulder 46 of a tubular shaft 47 and a nut 48 threaded on said shaft. Shaft 47 is freely rotatable but can not move axially with respect to bracket 40A. Shaft 47, which is made of pure copper, is mounted upon shaft 50 also of pure copper and is insulated therefrom by non-conducting member including a sleeve 51 of laminated Bakelite tubing.

Shaft 47 is provided with stainless steel inserts 52 for receiving screws 53 by which welding electrode 54 is attached to shaft 47 and is electrically connected therewith. Likewise shaft 50 is provided with stainless steel inserts 55 for receiving screws 56 by which welding electrode 57 is attached to the shaft 50 and is electrically connected therewith. A circular plate of insulation 58 separates the welding electrode disc 54 and 57 which are made of forged copper. Each disc is provided with a number of concentric circular grooves 59 in order to increase the radiating surface. Streams of water play upon these grooves in order to cool the electrodes.

Screws 62 secure to the bearing bracket 40B bearing retainers 60 and 61 between which a pin or small diameter roller bearing 63 is confined. The inner race 64 of which has a snug sliding fit with a reduced portion 65 of shaft 50. Thus, bearing 63 supports the right end of the shaft 50 but permits longitudinal movement thereof due to expansion and contraction with changes in temperature. The length of the shaft 50 between the bearing brackets 40A and 40B is relatively long therefore there will be an appreciable amount of expansion and contraction. But, practically all of this expansion and contraction takes place between the bearings 41 and 63. As the distance between the bearing 41 and electrodes 54 and 57 is relatively short the expansion of the shaft between the bearings and the electrodes is practically negligible.

A disc of pure copper 70 is attached by screws 71 to the flange 72 of shaft 47. The disc and

shaft are electrically connected by screws 71 and by pins 71a insulated from and drivingly connected with flange 50a of shaft 50. Disc 70 is insulated from shaft 50. Shaft 50 supports and is electrically connected with a disc of pure copper 73 mechanically and electrically connecting with the disc 70 by rods 74 of pure copper secured in position by copper nuts 75. The space between the discs 70 and 73 and between the shaft 50 and the rod 74 is occupied by a cylindrical, laminated transformer core 76 and a transformer primary 77 comprising a plurality of four-layer turns of flexible copper ribbon separated by insulating ribbons 79. The core 76 is suspended from the rods 74. As shown in Fig. 7 the core 76 extends through two aluminum spiders 80 of annular formation and integral with lugs 81, spaced 90°, and each provided with a socket 82 at its outer end for receiving a set screw 83 passing through a threaded hole in a rod 74. The primary and core assembly are insulated from the discs 70 and 73 and from the shaft 50 by non-conducting plates 85 and 86 and non-conducting sleeve 87.

The ends of primary 77 are connected by leads 90 and 91 with copper rings 92 and 93, respectively, insulatingly supported by a sleeve 94 and clamped thereon by a nut 95. The rings 92 are insulated from each other from the sleeve, from the nut 95 and from a spacer 96. Sleeve 94 is connected with shaft 50 by a key 97. The sleeve 94 is split by saw-cut at 98 and by saw-cut at 99 to provide a resilient clamping portion 100 cooperating the screws 101 which cause this clamping portion to grip the shaft 50. The secondary of the transformer is a single turn circuit comprising electrode 57, shaft 50, disc 73, rods 74, disc 70, shaft 47 and electrode 54.

Each collector ring 92 and 93 is engaged by two brushes 102 guided by brush holders 103 and urged by springs 104 into engagement with their respective collector rings. The brush holders 103 are supported by brackets 105 insulated from each other and insulatingly supported by bearing bracket 40B. Each brush holder 103 has a threaded part 106 threaded through the bracket 105 and engageable with a nut 107 for attachment of a terminal clip 108 connected with a cable 109.

As shown in Fig. 5, the tubing T to be welded passes between the welding electrodes 57 and 54 and a supporting or back-up roller 110 having a flange 111 engageable with only one electrode. The roller 110 which is made of copper is attached by screws 112 to the flange 113 of a shaft 114 journaled in ball bearings 115 carried by forked lever 116 pivoted upon a pin 117, supported by bracket 118 integral with a tubular shaft 119 (Fig. 11), supported vertically and journaled for rotation by tapered roller bearings 120, the outer races of which are supported by a sleeve 121 attached to a bracket 122 which is carried by a horizontal plate 123 resting on table 20. Roller 110 is caused to exert uniformly constant pressure upon the tubing T by the use of weights 124 attached at 126 by a cable 125 to lever 116. While the roller 110 is thus exerting the desired constant upward force upon the tubing T to secure proper welding pressure between the tubing and the electrodes, the roller 110 cooperates with the tubing T in the manner of a trolley wheel with a trolley. In other words, the roller 110 follows the tubing T and takes whatever position the tubing T may require due to the minute variations in shape or diameter. This welding machine is particularly adapted for welding small diameter steel tubing according to the method disclosed in

the copending application of Charles A. Nichols, Serial No. 384,563, filed March 21, 1941. To successfully weld small diameter tubing it has been found expedient to form the tubing out of round in order that it may be guided by guide wheels having grooves similarly formed so that the seam of the tube will be always on top or in alignment with the insulation plate 58 between the electrodes 54 and 57. The grooves provided by the electrodes and the groove provided by the roller 110 are shaped so as to accommodate the tubing which is slightly elliptical so that the tubing is welded out of round after having been formed out of round. As disclosed in the Nichols application, after welding takes place, the bead of excess metal at the seam is removed by a scarfing tool located vertically above the tubing. Obviously, the skewing or spiralling of the tubing must be prevented in order that the bead will always be moved into contact with the scarfing tool. Even after all of these precautions are taken to prevent skewing of the tubing, it sometimes happens that the tubing will spiral slightly thus displacing its seam from the vertical plane midway with the electrodes. I have discovered that such spiralling may be eliminated by slightly angularly displacing the plane of rotation of the central groove of roller 110 from the plane of rotation of the median line of insulation sheet 58. This is accomplished by moving the plate 123 about a pin 130 having a threaded shank 131 receiving a nut 132 by which the pin 130 is attached to the table 20. The axis of the pin is vertical and is represented by the point 130X (Fig. 12) intersecting the median line 110—Y of the groove in roller 110 and passing vertically upward as indicated by line 131—X (Fig. 5) and intersecting the axis of the tubing T and the median line of the groove provided by the electrodes 54 and 57. This adjustment may be effected by turning adjusting screws 133 (Fig. 12) each threaded through a lug 134 attached to table 20 and engaging lug 135 attached to plate 123.

During the continued use of the machine the tube-receiving groove provided by the electrodes becomes roughened and worn out of true due to the intense heat of the electric current passing between the electrodes and the tubing. This groove may be trued or resurfaced by the use of a cutting tool 140 which is part of a groove cutting apparatus 141 mounted upon the bearing bracket 40—A. Before using the groove cutting apparatus 141 the outer cylindrical surfaces of the electrodes are trued by a tool 142 mounted in a tool holder 143 of the conventional type also supported by the bearing bracket 40—A. While truing the electrodes they should be elevated above the roller 110. Before frame 40 is elevated by turning the handwheel 34 (Fig. 1), a shaft 144 (Fig. 12) is turned by a wrench fitting on the squared end 145 thereof in order to move an eccentric cam 146 (Fig. 11) under that portion of the lever 116 extending to the right of the bearing pin 117. The eccentric 116 then receives the pressure exerted by weights 124 and upward movement of roller 110 is prevented while the electrodes are being elevated preparatory to trimming.

While the machine is welding tubing the electrodes are rotated by movement of the tubing T between them and the rollers 110. The tubing T is propelled by the forming rolls which contact with the tube prior to welding and by the rounding or truing rolls which contact with the tube after welding. But, when the electrodes are be-

ing trued, they are rotated by a separate source of power comprising an electric motor 150 (Fig. 1) mounted on a frame 151 containing a gear reducing mechanism connecting the motor 150 with a shaft 152 attached to a pulley 153 connected by belt 154 with a pulley 155. Frame 151 is supported by frame 40. Pulley 155 (Fig. 10) is journaled on a bearing 156 provided by retainer plate 61. Pulley 155 (Fig. 8) pivotally supports at 157 a plurality of pawls 158 urged by leaf springs 159 into engagement with a fine tooth ratchet 160 connected by keys 161 with the extension 65 of shaft 50. Leaf springs 159 are fastened to the heads of the screw 159a attached to pulley 155. During welding the ratchet 160 rotates counterclockwise (Fig. 8) and the teeth thereof merely move under the pawls 158 which ride upon them with light pressure. When the electric motor drives the pulley 155 counterclockwise (Fig. 8) motion is transmitted from the pulley to the shaft 50 through the pawls 158 the ratchet 160.

The ratchet 160, Fig. 5, is retained by a washer 162 and a nut 163 threaded in the shaft 50. The nut 163 is integral with a pipe coupling 164 welded to a tube 165 extending through a central hole 166 in shaft 50 and terminating near the plug 167 in the left end of the shaft 50, Fig. 5. Water for cooling the shaft 50 enters through a passage 168 and flows through the tube 167 and then back around the outside of the tube toward the right and out through a passage 169 in plug 163. Plug 163 includes an extension 170 (Fig. 5a), around which is swivelled a conventional two-hose fitting (not shown) having separated annular ducts cooperating with side inlet 168a and side outlet 169a of the extension 170.

While the embodiment of the present invention as herein disclosed, constitutes a preferred form, it is to be understood that other forms might be adopted, all coming within the scope of the claims which follow.

What is claimed is as follows:

1. An electric welder comprising rotatable electrode discs separated by insulation and together providing a groove for receiving a butt-seam tube to be welded, a grooved tube supporting roller for retaining the tube against the electrodes and rotatable about an axis generally paralleling the axis of rotation of the electrodes, a lever rotatively supporting the roller, means for exerting a constant force upon the lever to urge the roller against the tube and the tube against the electrodes with constant pressure, and means for swivelly supporting the lever for movement about an axis at right angles to the axes of rotation of the electrodes and roller in order that the roller may track with the tube.

2. An electric welder comprising electrode discs rotatable on a horizontal axis separated by insulation and together providing a groove for receiving a butt-seam tube to be welded, a grooved tube supporting roller for retaining the tube against the electrodes and rotatable about

an axis generally paralleling the axis of rotation of the electrodes, means for supporting the roller with its axis substantially vertically below the axis of the electrodes, said means comprising a lever supporting the roller at one end, a bracket pivotally supporting the lever on a horizontal axis intermediate its ends, a weight connected with the other end of the lever in order to force the roller upwardly against the tube with constant pressure and a bearing swivelly supporting the bracket for rotation about a vertical axis spaced from the horizontal axis of the lever and at right angles to the axes of rotation of the electrodes and the roller.

3. An electric welder comprising electrode discs rotatable on a horizontal axis separated by insulation and together providing a groove for receiving a butt-seam tube to be welded, a grooved tube supporting roller for retaining the tube against the electrodes, means for supporting the roller with its axis substantially vertically below the axis of the electrodes, said means comprising a lever supporting the roller at one end, a bracket pivotally supporting the lever on a horizontal axis intermediate its ends, a weight connected with the other end of the lever in order to force the roller upwardly against the tube with constant pressure, bearing swivelly supporting the bracket for rotation about a vertical axis spaced from the horizontal axis of the lever, a bracket supporting the bearing and rotatable about a pivot vertically below the axis of the electrodes and means for adjusting the last mentioned bracket about its pivot.

4. An electric welder comprising electrode discs separated by insulation and together providing a groove for receiving a butt-seam tube to be welded, a grooved tube supporting roller for retaining the tube against the electrodes, means for rotatively supporting the roller with its axis substantially parallel to the axis of the electrodes, and provisions for adjusting said means whereby the axis of the roller may be angularly displaced, relative to the axis of the electrodes, about an axis which intersects the axis of the tube where the tube contacts with the electrodes.

5. A welder according to claim 4 in which the roller supporting means includes a lever for rotatively supporting the roller, a bracket for pivotally supporting the roller about an axis parallel to the roller axis but spaced therefrom and a bearing for supporting the bracket for rotary movement about an axis at right angles to the axis of the lever and spaced therefrom.

6. A welder according to claim 4 in which the roller supporting means includes a lever for rotatively supporting the roller, a bracket for pivotally supporting the roller about an axis parallel to the roller axis but spaced therefrom and having a tubular sleeve whose axis is at right angles to the lever axis and is spaced therefrom, and a bearing for rotatively and axially supporting said sleeve.

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