

June 29, 1948.

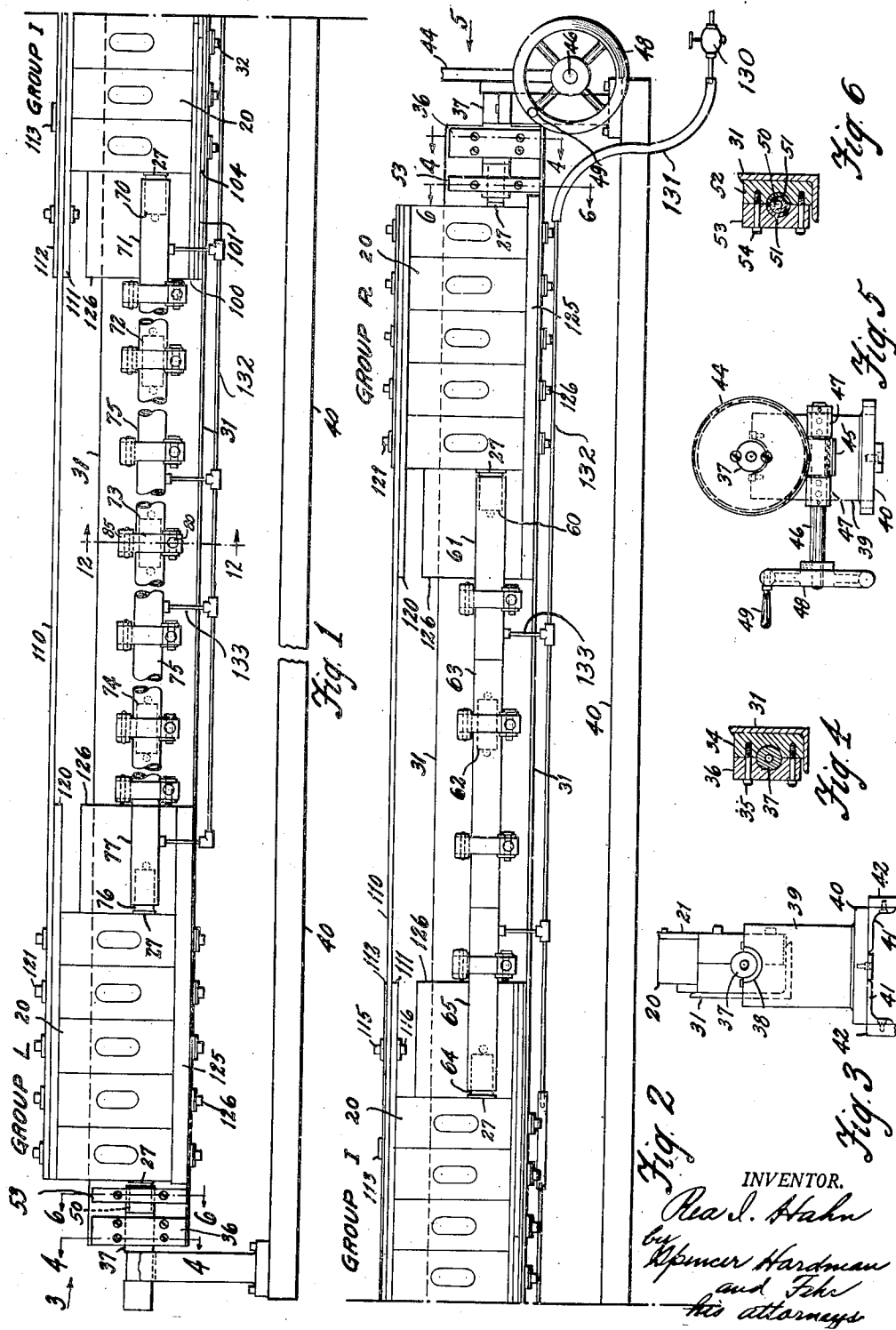
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2,444,348

ELECTRIC ANNEALING APPARATUS

Filed April 16, 1947

2 Sheets-Sheet 1



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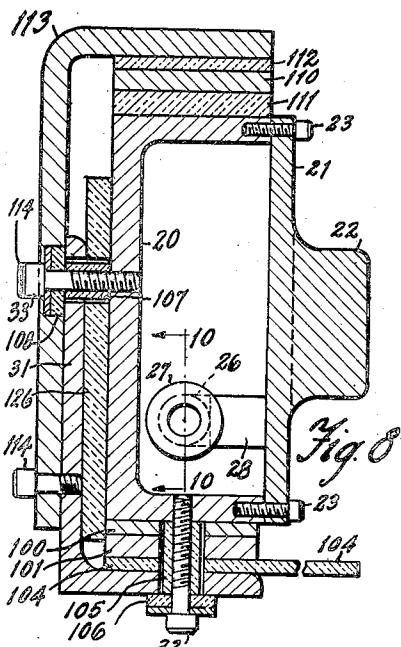


Fig. 8

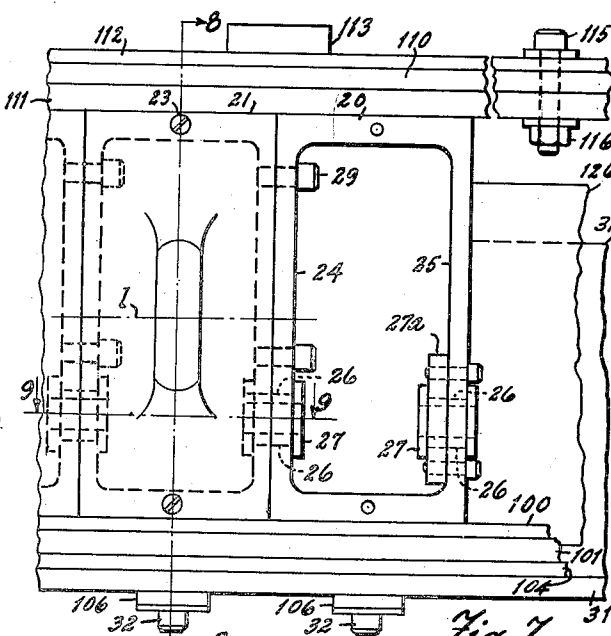


Fig. 7

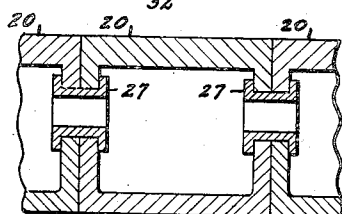


Fig. 9

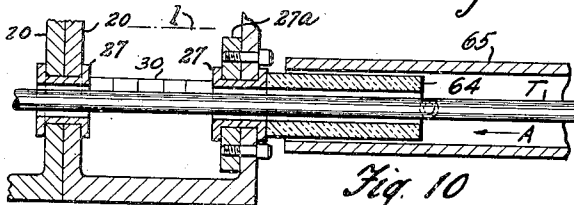


Fig. 10

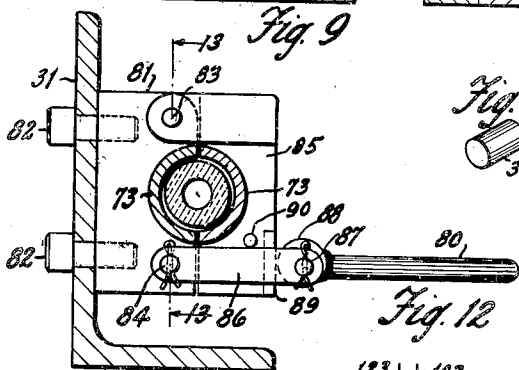


Fig. 12



Fig. 11

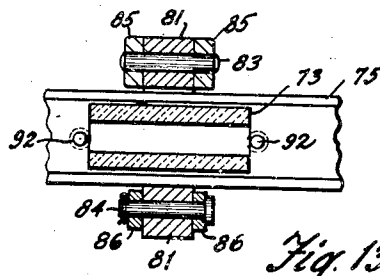


Fig. 13

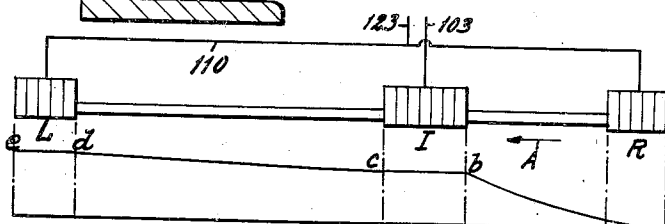


Fig. 14

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ELECTRIC ANNEALING APPARATUS

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1 Claim. (Cl. 219—11)

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This invention relates to apparatus for annealing continuously moving lengths of metal rods, tubing, wire and the like, for example, the type of apparatus disclosed in Wirt and Fletcher Patent No. 2,293,873. According to this patent, the material is heated, as it travels, by passing electric current through it to raise its temperature to that required for annealing. In order to connect the material with a source of electric current, the material contacts metal pellets contained in metal, electrode-boxes connected with the current source.

An object of the invention is to provide improved electrical connections between the material and the electrode boxes. This is accomplished by using, instead of metal pellets of roughly spherical shape, short, cylindrical rods of non-abrasive, conducting material similar to that used for commutator brushes. Preferably these rods are made by sintering a mixture of finely divided copper and graphite about in the proportion of 60% copper and 40% graphite. For material such as tubing around $\frac{1}{4}$ inch to $\frac{1}{2}$ inch in diameter, satisfactory results are obtained by using rods $\frac{1}{4}$ inch in diameter and $\frac{3}{8}$ " to $\frac{7}{8}$ " long. As the material moves axially through the masses of rods contained in the boxes, these rods tend to line up parallel to the moving material and to each other and thus provide line contact of lower resistance than the point contact obtained by the use of roughly spherical pellets.

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:

Figs. 1 and 2 together constitute a front view of apparatus embodying the present invention.

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

Fig. 4 is a sectional view on line 4—4 of Figs. 1 and 2.

Fig. 5 is a view in the direction of arrow 5 of Fig. 2.

Fig. 6 is a sectional view on line 6—6 of Figs. 1 and 2.

Fig. 7 is a fragmentary front view showing one electrode box with cover and one without cover.

Fig. 8 is a sectional view on line 8—8 of Fig. 7.

Fig. 9 is a sectional view on line 9—9 of Fig. 7.

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

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Fig. 11 is a perspective view of a rod for conducting current to the material being annealed.

Fig. 12 is a sectional view on line 12—12 of Fig. 1.

Fig. 13 is a sectional view on line 13—13 of Fig. 12.

Fig. 14 is a diagram of electrical connections and corresponding temperature changes.

The electrode boxes 20 are alike except for certain tapped holes. Each has a cover 21 provided with a handle 22 and attached to the box by screws 23. The side walls 24 and 25 are notched at 26 to receive a metal coupling-bushing 27 retained by lugs 28 which are integral with the cover 21 and is received by the notches 26. The coupling-bushing 27 and screws 29 tie the boxes together. As shown in Figs. 1, 2 and 14 the boxes are arranged in two end groups of five boxes each and an intermediate group of seven boxes since the latter group conducts more current than the end groups. As shown in Fig. 9, each bushing 27 spans two wall thickness. In order that the same bushings 27 can be used at a box wall at an end of a group, a spacer 27a is attached to provide the necessary wall thickness. Each box 20 receives a quantity of rods 30 made of good contact material as previously specified. The quantity is such as to fill the box to a level substantially above the material (tubing T for example) as indicated by line L (Fig. 7). As the tubing moves longitudinally as indicated by arrows A (Figs. 11 and 14), the rods 30 tend to align themselves parallel to the tubing as indicated in Fig. 10 so as to provide a line contact with the tubing. The rods above those in contact with the tubing also tend to make line contacts with each other so that fairly good electrical paths are provided between the boxes and the tubing. When the boxes are inverted the rods gravitate to spaces below the bushings 27 so that the tubing can be easily threaded through the boxes.

To provide for inversion of the boxes, they are mounted upon an invertible angle bar 31 and attached thereto by screws 32 and 33 and are insulated therefrom in a manner to be described. At each end of the bar 31, there is welded a clamp plate 34 to which screws 35 attach a clamp plate 36 with a short, tubular shaft 37 between. The two shafts 37 and all of the bushings 27 attached to the boxes are in alignment. The shafts 37 are journaled in bearings 38 carried by brackets 39 attached to a table plate 40 which angles 41 (Fig. 3) attach to legs 42 which support the table 45 above the floor. The right end shaft 37 (Fig. 5)

is attached to a worm gear 44 which meshes with a worm 45 attached to a shaft 46 journaled in bearings 47 attached to the right end bracket 39. Shaft 46 is rotated by a wheel 48 having a crank handle 49 in order to invert the angle 31 and the boxes 20 when rethreading of the tubing or other material is required.

The tubing passes first through the right end shaft 37 and then through a short, refractory, non-conducting tube 59 (Fig. 6) clamped between two copper half-shells 51 clamped between a steel block 52 (welded to angle 31) and a cast bronze block 53 attached by screws 54 to block 52. Tube 59 abuts the right end of the right end bushing 27 of right end group of boxes 20 marked group R in Fig. 2. The tubing passes next through group R, boxes 20 and then through a refractory tube 63 within a copper tube 61 and through a refractory tube 62 within copper half-shells 63 and through a refractory tube 64 within a copper tube 65. Tube 64 abuts the right end of the right end bushing 27 of the intermediate group of boxes 20 marked group I. After passing through the box group I, the tubing passes through a refractory tube 70 within a copper tube 71 and through refractory tubes 72, 73 and 74 within copper half-shells 75 and through a refractory tube 76 in a copper tube 77. Tube 76 abuts the right end of the right end bushing 27 of the left end group of boxes 20 marked group L. The left end bushing 27 of the L boxes abuts another refractory tube 50 (Fig. 6) and the latter abuts the left end tubular shaft 37. After passing through the boxes of group L, the tubing passes out through the left end tube 50 and left end shaft 37.

The refractory tubes are made of lava. They can be replaced without disturbing the boxes 20 by the manipulation of clamping levers 80 which cooperate with devices which secure the complete copper tubes 60, 65, 70, 77 or the copper half-shells 63, 75 in position. For example, as shown in Fig. 12, a steel block 81 is attached by screws 82 to angle 31 and carries pivot rods 83 and 84. Rod 83 provides a pivot for a cast bronze block 85 which is held in the position shown to secure the copper half-shells due to the operation of links 86 connecting the pin 84 with a pin 87 passing eccentrically through the hub 88 of lever 80. When lever 80 is located as shown, its hub wedges against a hardened steel wear piece 89 provided by block 85. Pins 90 in block 85 limit upward movement of links 86. By pushing down on lever 80, the clamp block 85 is quickly released so that the front half-shell 73 can be removed to provide access to the tubes 72, 73, 74 which are located by screws 92 threaded through the back half-shell 73. Since tubes 60, 64, 70, 76 are located at one end only of tubes 61, 65, 71, 77 respectively, the latter can be complete tubes instead of being split.

The manner of making electrical connections with the boxes of group I is shown in Fig. 8. Bus bars 100, 101 connected by wire 103 (Fig. 14) of a current source are clamped against the boxes 20 with insulating bar 104 between bar 101 and the angle 31. The clamping screws 32 are insulated by bushings 105 and washers 106. Screws 33 are insulated by bushings 107 and washers 108.

Bus bar 110 which connects together the end groups R and L is shown between insulating bars 70

111 and 112. Bars 110, 111 and 112 are retained by brackets 113 which screws 114 attach to angle 31. Near the ends thereof, bars 111 and 112 are clamped to bar 110 by screws 115 and nuts 116 (Figs. 1, 2 and 7). Each end portion of bar 110 together with a conducting bar 120 is attached by screws 121 to the boxes of the end groups. A wire 123 (Fig. 14) connects bar 110 with the current source.

The end groups of boxes are clamped against non-conducting plates 125 supported by the horizontal leg of the angle 31 by screws 126 insulated from the angle and threaded into the boxes. The screws 33 which secure all of the boxes to the vertical leg of the angle pass through insulating plates 126 located between the vertical leg and the backs of the boxes as shown in Fig. 8.

The distance between the intermediate box group I and the group R is less than between groups I and L so that the resistance of the material (tubing) being annealed will be less between groups R and I than between groups I and L. Consequently the material will conduct more current between groups R and I than between groups I and L. As shown in Fig. 14, line *a-b* represents a relatively rapid increase of material temperature (to 1300° or 1400° F., for example). Line *c-d* shows less temperature increase (about 200° F. increase, for example). Therefore, as the material passes through the annealer, its temperature increases relatively rapidly during a certain period of time and then increases relatively slowly for a longer period of time. By changing the relative spacing of the box groups, the annealing cycle can be changed to suit the material being treated. If larger material requires more current for the annealing operation, more boxes with rods 30 can be added to each group.

Inert or reducing gas for preventing oxidation of the tubing as it is annealed is conducted under pressure from a source, not shown, through a valve 130, hose 131, manifold piping 132 and branch pipes 133 to the passageways for the tubing provided by the parts 61, 65, 71, 75 and 77.

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:

Apparatus for annealing continuously moving material, such as metal tubing, wire and the like, comprising an electrode support, metal electrode-boxes located in groups on the support and providing aligned openings therethrough for the passage of the material, material encasing means located between the groups of boxes and providing non-conducting supports for the material as it passes between the boxes, means for connecting the box groups with a current source and means in each box for making electrical connection between the box and the material passing there-through, said means comprising a quantity of short, cylindrical rods sufficient to submerge the material, said rods being made of non-abrasive, conducting material and being of such size that, due to the motion of the material through them, a substantial portion of them become axially parallel to the material and to each other.

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