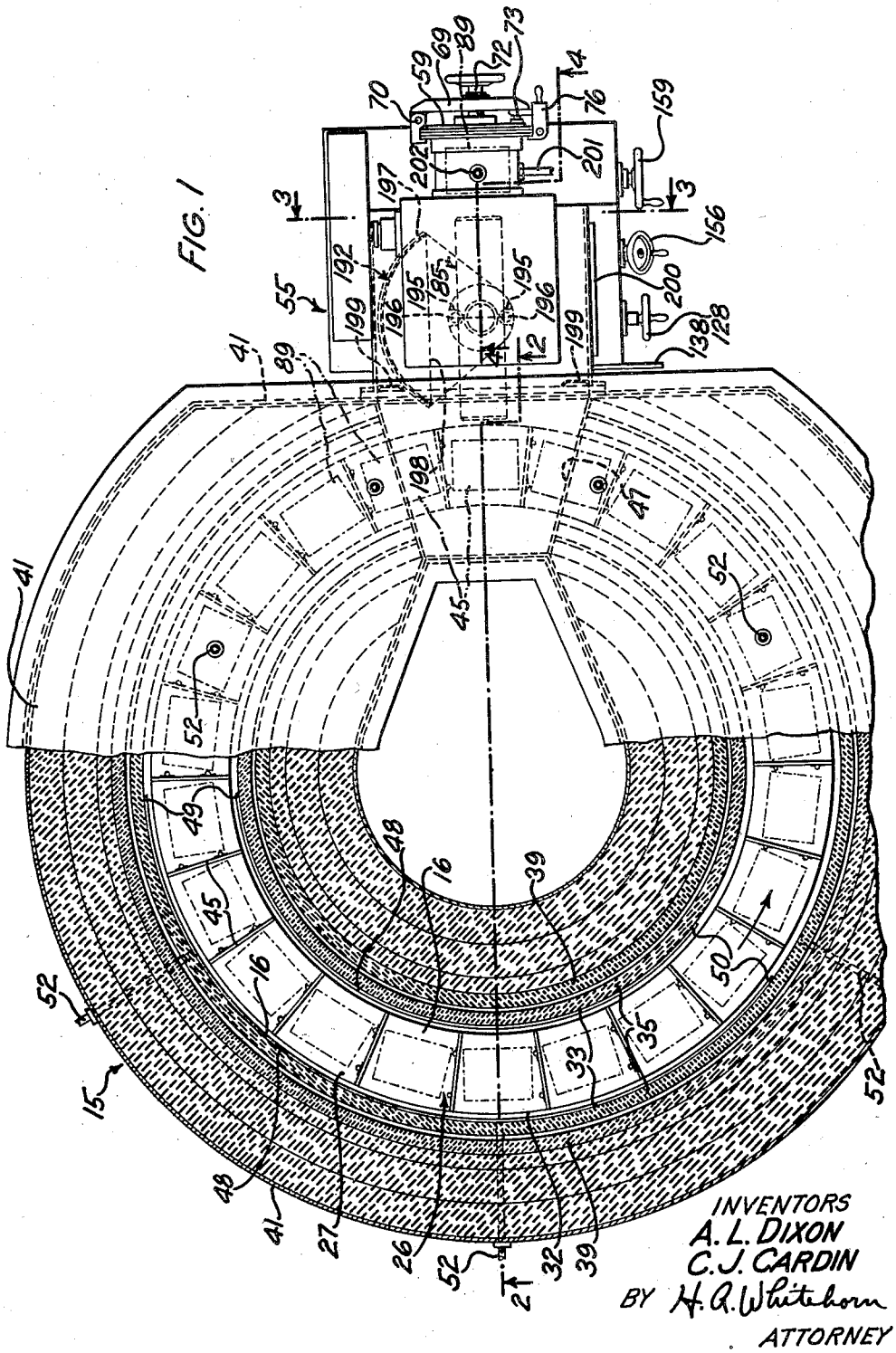
Aug. 4, 1936. A. L. DIXON ET AL 2,049,950

FURNACE

Filed Feb. 27, 1934 5 Sheets-Sheet 1

FIG. 1



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FURNACE

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FIG. 2

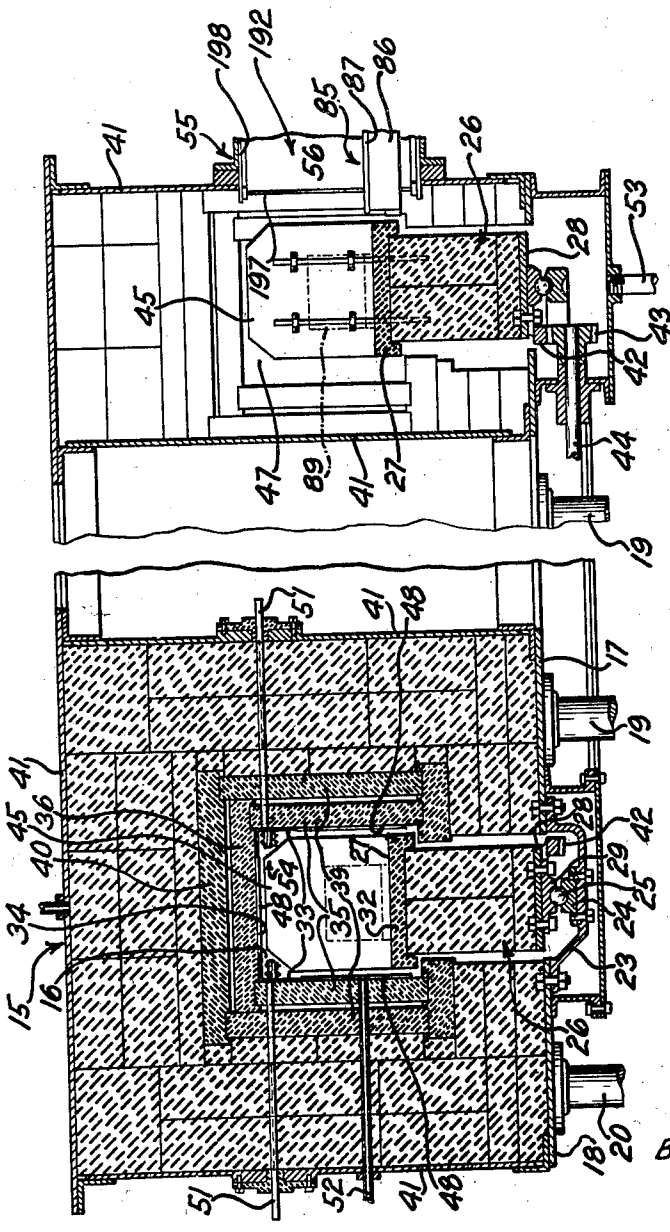
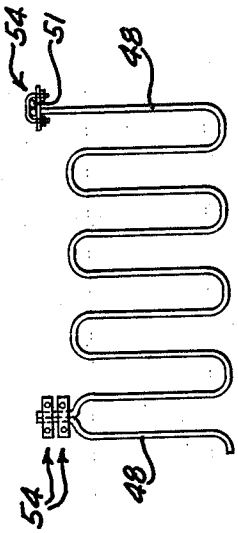


FIG. 8



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FURNACE

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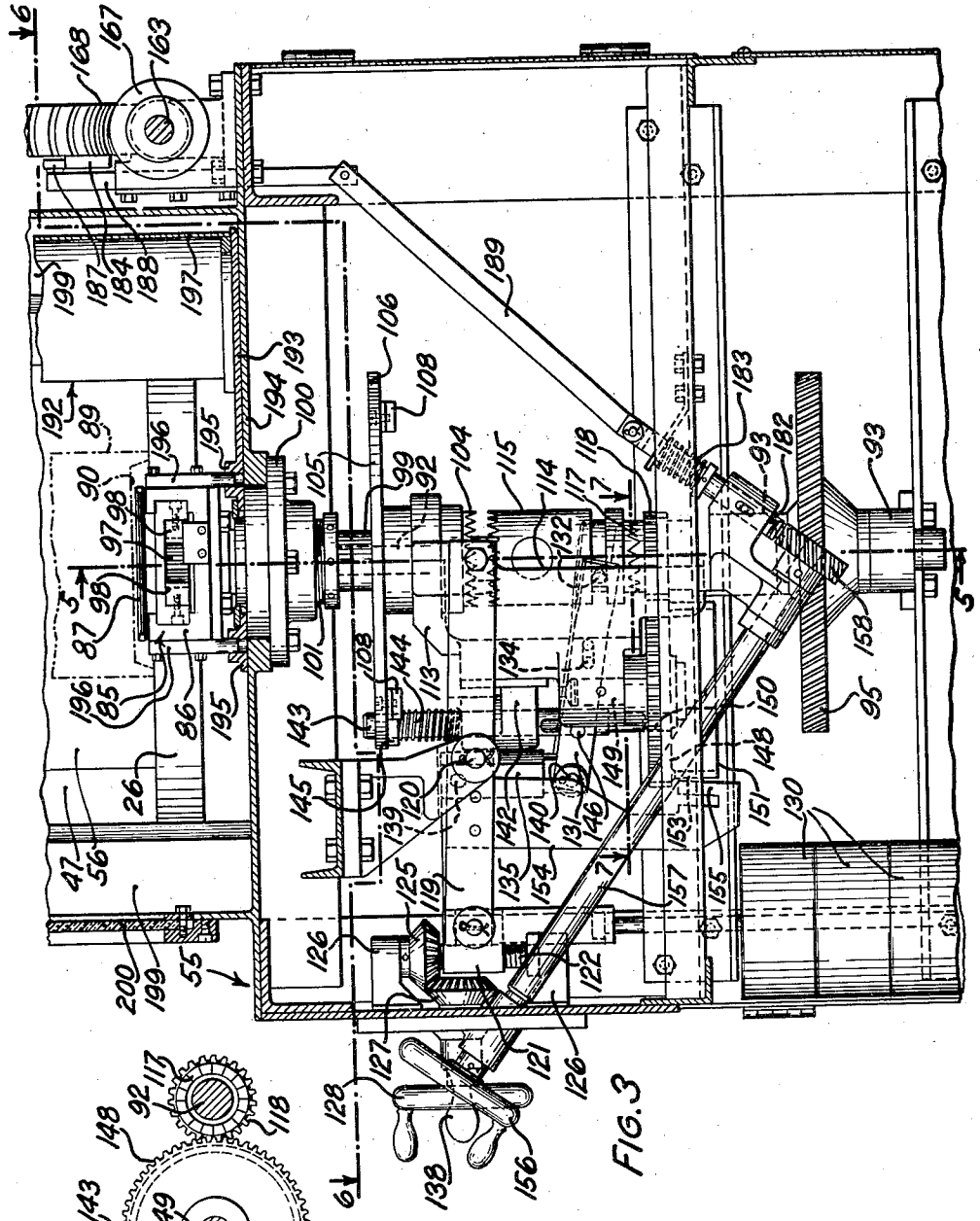

FIG. 3

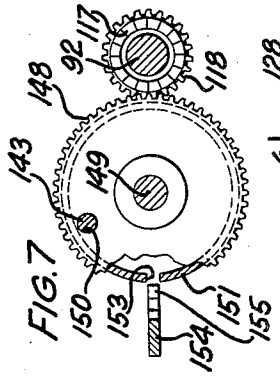

FIG. 7

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Filed Feb. 27, 1934 5 Sheets-Sheet 4

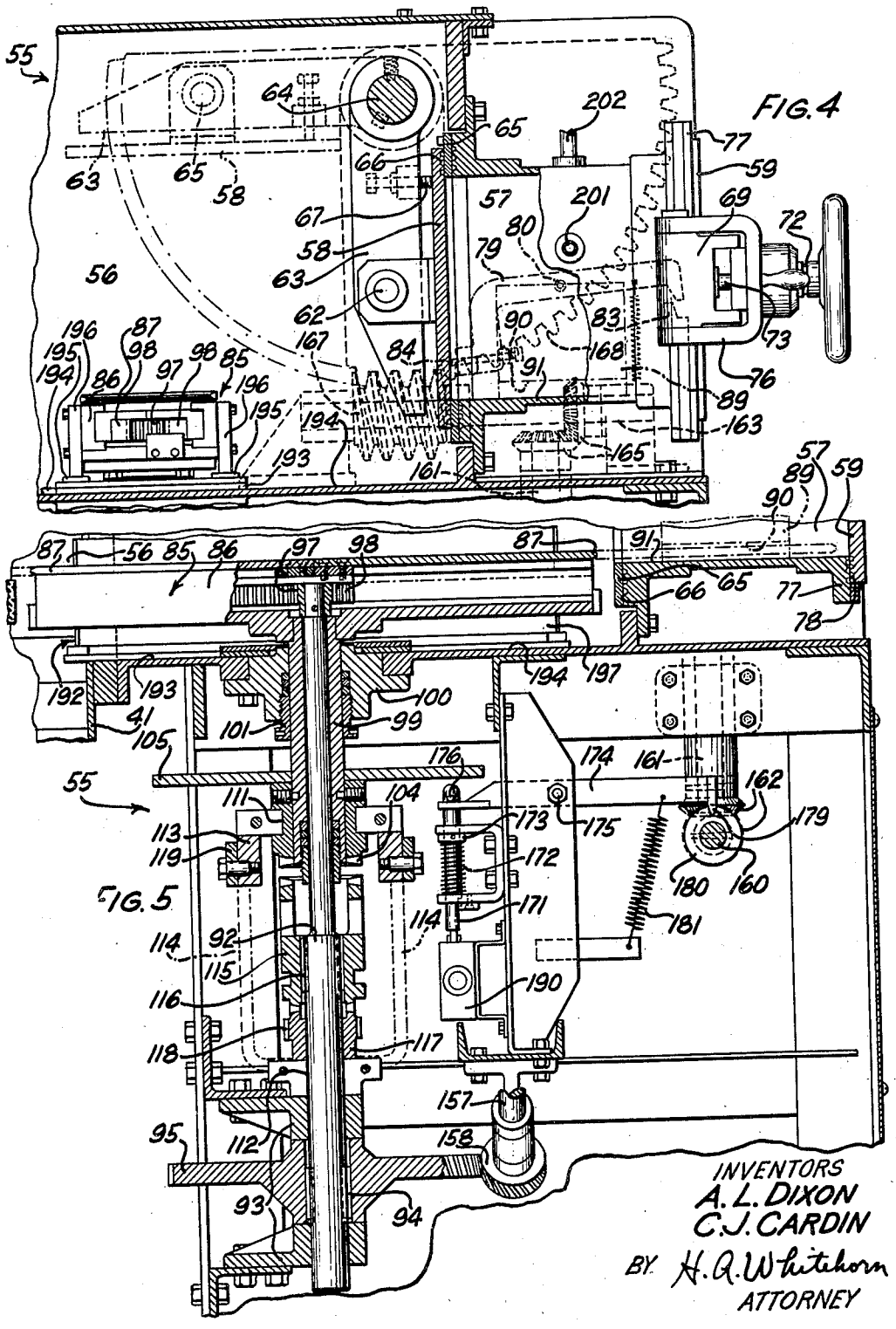

FIG. 4

FIG. 5

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Filed Feb. 27, 1934 5 Sheets-Sheet 5

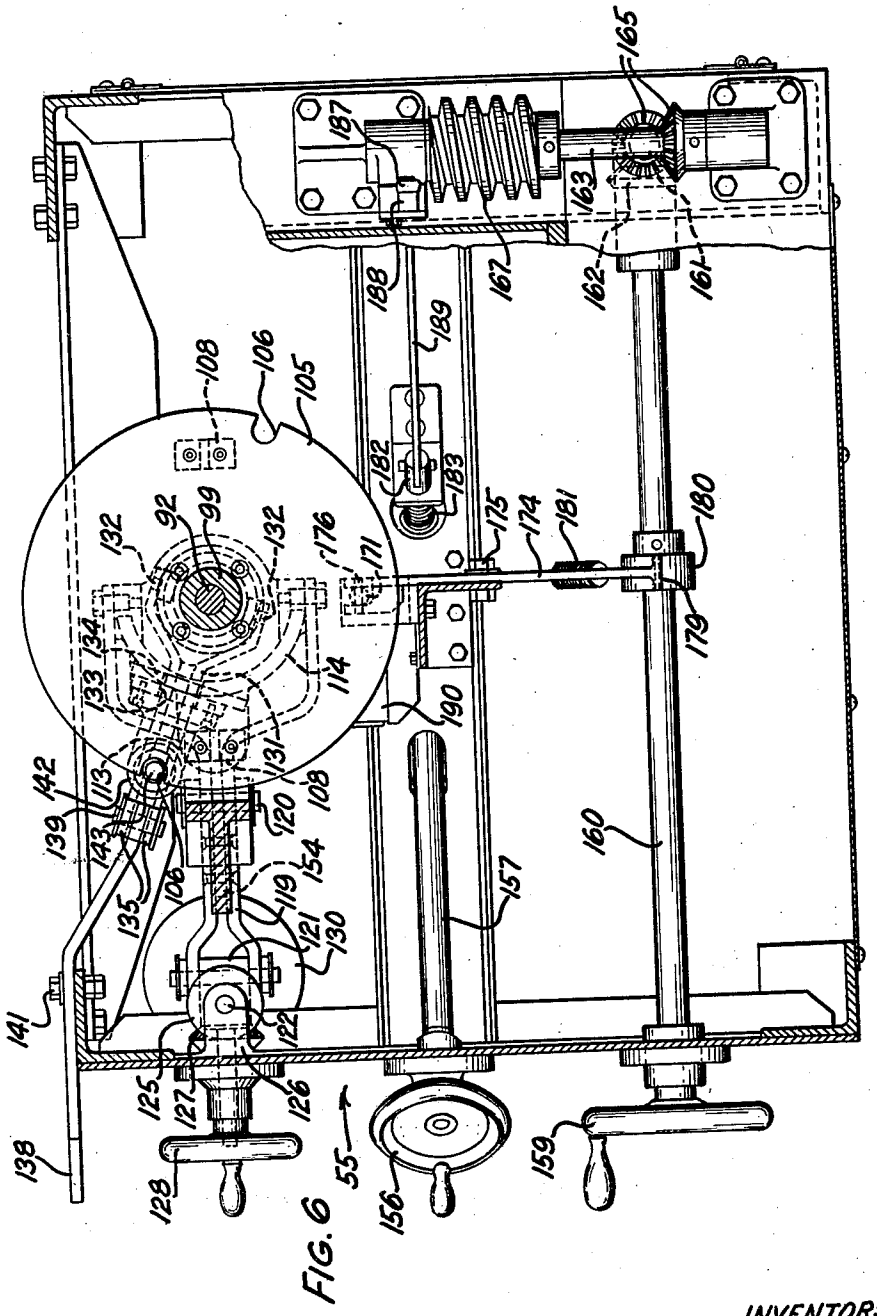

FIG. 6

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UNITED STATES PATENT OFFICE

2,049,950

FURNACE

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Application February 27, 1934, Serial No. 713,114

21 Claims. (Cl. 263—7)

This invention relates to furnaces, and more particularly to electrically heated rotary hearth furnaces having a non-oxidizing atmosphere and work charging and discharging means.

An object of the invention is to improve the construction of furnaces of the character above described and provide improved means for efficiently and expeditiously charging and discharging said furnaces of work without admitting air into the furnace.

In accordance with one embodiment of this invention, a furnace is provided which includes an intermittently rotatable annular hearth and an annular heating chamber having a non-oxidizing atmosphere in which the work being treated is carried by the hearth. The chamber is heated by sectional molybdenum electrical resistance elements which are clamped to each other and to electrical terminals at points within the chamber and exposed to the non-oxidizing atmosphere. The furnace is at all times completely sealed, the work being charged into and discharged therefrom by means of an air lock and associated work transfer means, whereby the work is transferred from an initial atmosphere of air in the lock into the furnace non-oxidizing atmosphere in the heating chamber and discharged vice versa without admitting any substantial amount of air to the furnace. This is accomplished by placing the work in the lock, exhausting the air therefrom, and then filling it with a non-oxidizing gas, whereupon the transfer means is operated to move the work to be treated from the lock onto the hearth, which is stationary at this time, and simultaneously therewith transfer treated work from the hearth into the lock. The work transfer means is hand operated by means of hand wheels and a lever, the operation of which is controlled by interlocking devices to insure proper sequence of operations for charging and discharging the furnace of work without admitting air to the non-oxidizing atmosphere in the heating chamber. Means is also provided for insuring that the rotary hearth will remain stationary during the operation of the work transfer means.

Other features and advantages of this invention will more fully appear from the following detailed description, taken in connection with the accompanying drawings, in which—

Fig. 1 is a fragmentary plan view, partly in section, of a furnace embodying the features of this invention;

Fig. 2 is an enlarged fragmentary vertical section taken on the line 2—2 of Fig. 1;

Fig. 3 is an enlarged vertical section taken on the line 3—3 of Fig. 1;

Fig. 4 is an enlarged vertical section taken on the line 4—4 of Fig. 1, showing the turn-table rotated 90° from the position shown in Fig. 1 and the inner door in closed position;

Fig. 5 is a fragmentary vertical section taken on the line 5—5 of Fig. 3;

Fig. 6 is a fragmentary plan section, partly in elevation, taken on the line 6—6 of Fig. 3;

Fig. 7 is a detail plan section taken on the line 7—7 of Fig. 3, and—

Fig. 8 is a fragmentary view of an electrical heating element for the furnace heating chamber showing the method employed for securing it to a terminal within the chamber and to adjacent ends of the element.

General

Referring now to the drawings, particularly Figs. 1 and 2, a substantially circular furnace 15 having an annular heating chamber 16 is built upon a pair of spaced inner and outer steel rings 17 and 18 supported on inner and outer groups of standards 19 and 20, respectively. The rings 17 and 18 are connected by an annular steel support 23 which carries a ball race 24 for receiving ball bearings 25. An annular rotatable hearth 26 having a floor 27, within the chamber 16, is built upon a steel ring 28 which carries a ball race 29 on its under surface for receiving the ball bearings 25. To prevent the heat from the chamber 16 being readily transmitted to the ball bearing support 23, the hearth 26 is quite deep and built up from refractory heat insulating bricks and the top thereof, providing the hearth floor 27, comprises a slab of refractory 32. Annular side walls 33 of the heating chamber 16 which extend from a point slightly below the lower edge of the slab of refractory 32, at the top of the hearth, for a suitable distance upwardly, and a top wall 34 of the chamber comprise slabs of refractory 35 and 36, respectively. Spaced from the inner refractory slabs 35 and 36 are similar outer slabs 39 and 40, outside of which is a suitable thickness of heat insulating bricks covered with steel plates 41. The steel plates 41 in cooperation with the bottom steel rings 17 and 18 and an annular bottom steel enclosure interconnecting the rings comprise an air and gas tight enclosure for the furnace. In case the bricks abutting the outer slabs 39 and 40 tend to sag the latter, the space provided between them and the inner slabs 35 and 36 prevents the inner slabs from being deformed sufficiently to cause interference with the work

being carried in the chamber 16. The supporting steel ring 28 of the annular hearth 26 has fixed thereto an annular gear 42 which meshes with a pinion 43 secured to a shaft 44 which is intermittently driven from an electric motor through a speed reducing mechanism (not shown) at a desired speed to rotate the hearth 26 in a counterclockwise direction, as indicated by the arrow (Fig. 1). A suitable timing mechanism (not shown) is associated with the driving mechanism, which includes an electric motor circuit, for the shaft 44, which causes the shaft to make one revolution each hour, for instance, and then stop. The pinion 43 is of such a size relative to the annular gear 42 that during the one hour period of revolution of the shaft 44 the hearth 26 will be moved one-twenty-second of a revolution and then stopped, the stopping of the hearth being indicated to the operator by the ringing of a bell included in a circuit which is closed when the hearth stops. After the operator discharges and charges the furnace in a manner to be described hereinafter, he closes the motor circuit for the hearth driving mechanism by pressing a starting button and the rotation of the hearth continues. The timing mechanism and the motor and bell circuits are not shown in the drawings, since they do not form a part of the present invention and are not believed necessary to a complete understanding thereof. Thus the hearth 26 will be rotated in twenty-two steps and if a charge of work is placed upon the hearth during one stationary period it will again be stepped to a proper position to be discharged in a subsequent stationary period.

Referring now to Fig. 1, the furnace at its right side is provided with an opening 47 through which the material or articles to be treated are charged onto and discharged from the rotatable hearth 26, within the chamber 16 of the furnace. The chamber 16 is heated by a plurality of electrical resistance elements 48 made from molybdenum metal, the elements being clamped together and supported from and extending solely along the annular side walls 33 and the top wall 34 of the chamber from the point 49 to the point 50 (Fig. 1). Terminals 51, also made from molybdenum metal, connect the heating elements 48 to a source of electrical current supply. The heating elements 48 are preferably made from molybdenum, a metal which is highly resistant to heat when in an non-oxidizing atmosphere, and are directly and solely exposed to a hydrogen gas atmosphere in the chamber, the gas being supplied through a plurality of inlets indicated at 52. An outlet for the gas is indicated at 53. The gas inlets 52 at the top of the furnace extend through the plates 41 to the outer surface of the heat insulating bricks (Fig. 2) for the purpose of flushing the brick structure of entrapped air, the gas entered therein trickling through the brick structure to the gas outlet 53 and thence to suitable means (not shown) for disposing of it. Since the heating elements 48 extend only between the points 49 and 50, the materials to be treated charged into the furnace at the opening 47 will be gradually heated as they approach the first point 49, and from the last point 50 to the discharge opening 47 the materials are cooled. For this reason the same amount of insulation is not required in the annular wall of the furnace at each side of the opening 47 as in the portion where the heating elements 48 are located.

The electrical heating elements 48 which extend between the points 49 and 50 comprise a plurality of sections, each section comprising three joined lengths of molybdenum metal of a suitable cross-section formed into a plurality of bends which extend along the side walls and the top wall of the heating chamber 16, the ends of the joined lengths being connected to the molybdenum terminals 51. The three lengths of heating elements forming each section of heating elements 48 are joined to each other and to the terminals 51 at points within the chamber 16 by U-shaped bolts and clamp plates indicated in general at 54 (Fig. 8) constructed from molybdenum metal similar to the heating elements and terminals. Fig. 8 illustrates fragmentarily one of the lengths of heating elements 48 connected at one end to a terminal 51 by a clamp 54 and another clamp is shown between two lengths of heating elements. It has been found that this method of joining or clamping together lengths of molybdenum heating elements or to the terminals thereof provides an effective and convenient method of building up the resistor. Since the molybdenum is in an non-oxidizing atmosphere it remains bright and forms a good electrical connection having practically no contact resistance when clamped together and the clamps presenting a larger radiating area remain cooler than the element and prevent burning out at the joint. These clamps may also be used for repairing heating elements which have become broken.

Attached to and movable with the rotary hearth 26 are a plurality of equally spaced vertically extending baffle walls 45 (Figs. 1 and 2) composed of refractory material and of a shape which substantially fills the space between the side and top walls of the furnace chamber 15 and the floor of the hearth but freely permitting the free movement of the hearth. The walls 45 provide in the present embodiment twenty-two compartments extending around the hearth into each of which a charge of work may be placed. These baffle walls substantially prevent circulation of the heated gaseous medium so that the temperature in any given zone of the furnace will depend upon the heat applied to that zone.

Air lock and work transfer mechanism

The work to be treated in the furnace is charged and discharged through the opening 47 into the chamber 16 and onto and from the hearth 26 by a work transfer and air lock mechanism indicated in general at 55 at the right side of Figs. 1 and 2. In the operation of the furnace and the associated mechanism 55, work which has been treated is withdrawn from the furnace through the opening 47 and positioned in the air lock, and simultaneously therewith work to be treated is removed from the air lock and inserted through the opening into the furnace. Referring particularly to Figs. 3, 4 and 5 the mechanism 55 which is bolted onto the furnace at the opening 47 with sealing gaskets interposed between the outer steel shell provided by the plates 41 of the furnace and the mechanism, comprises a metal housing divided into inner and outer chambers 56 and 57, the inner chamber being larger than the outer chamber. An inner door 58 closes the chamber 56 from the chamber 57 and the latter chamber is equipped with an outer door 59. The inner door 58 is pivotally carried, as indicated at 62 (Fig. 4), upon an arm 63 fixed to a horizontal rotatable shaft 64, the

shaft being rotatable in either direction, by means which will be described hereinafter, to open and close the door 58. The door 58, due to its pivotal mounting 62, alines itself with a door frame 65 between the chambers 56 and 57. Gaskets 66 are carried upon the opposed surfaces of the door 58 and the frame 65 to form an air-tight seal when the door is closed. Adjustable stop pins 67 carried by the arm 63 serve to limit the movement of the door 58 about the pivot 62 when the door is opened.

The outer door 59 is carried upon an arm 69 which may be swung about a vertical axis 70 (Fig. 1), the connection between the door and the arm comprising a hand screw 72 threaded through an aperture in the arm and connected at its inner end with the door so that the door may be moved by rotating the hand screw. A pin 73 fixed to the door 59 extends loosely through an opening in the arm 69 to prevent the door from rotating upon the arm. A U-shaped hand actuated catch 76 is pivoted upon the mechanism 55 and arranged to be swung over the free end of the arm 69 when the latter is turned to its door closing position. When the catch 76 is thus positioned, the hand screw 72 may be rotated to move the door 59, connected to the screw, into position against a door frame 77, the thrust of the screw outwardly being taken by the catch. The opposed surfaces of the door 59 and the frame 77 are equipped with gaskets 78 (Fig. 5) to provide an air tight seal for the chamber.

Interlock between inner and outer doors

In the operation of the air lock and work transfer mechanism 55, it is necessary, in order that the furnace remain sealed from atmosphere, that the outer door 59 be locked, that is, prevented from being opened when the inner door 58 is opened. This is effected by a spring drawn latch 79 pivoted at 80 to the inner side wall of the outer chamber 57, the latch being drawn into locking engagement with a keeper 83, fixed to the inner surface of the outer door 59, when the inner door 58 is swung open. When the door 58 is closed, the door is moved into engagement with an adjustable pin 84 carried by the latch 79, which swings the latter counterclockwise to move it from locking engagement with the keeper 83 on the outer door 59 to the position shown in Fig. 4. Also by means, which will be described hereinafter, the inner door 58 is prevented from being opened during certain steps in the operation of the mechanism 55.

Turn-table of work transfer mechanism

Disposed in the inner and larger chamber 56 is a rectangular shaped turn-table 85 (Figs. 3, 4 and 5) comprising a frame 86 having slides 87 at opposite ends of the frame guided therein and extensible therefrom and retractable thereto, the upper surfaces of the slides being in the plane of the upper surface of the frame. The work to be heat treated in the furnace is loaded into trays 89 composed of ceramic material, the trays being formed with U-shaped openings 90 at their bottoms for the reception of the slides 87, which are slightly tapered along their upper and lower edges at their outer ends so that they will freely enter the openings in the trays. In placing a tray 89 in the outer chamber 57, it is predeterminedly positioned on a floor 91 of the outer chamber 57 so that when one of the slides 87 is extended it will freely enter the opening 90 in the tray. In the operation of the work transfer mechanism 55 when the turn-table 85 has been rotated to the proper position, the slides 87 may be simultaneously extended so that one slide will be entered in the opening 90 of the tray 89 carrying treated work or material and carried on the annular hearth 26 and the other slide will be entered in the opening 90 of the tray 89 carrying work or material to be treated and which has been positioned in the small outer chamber 57, the inner and outer doors 58 and 59 at this time being opened and closed, respectively, and the hearth 26 at a standstill. The turn-table 85 in addition to its rotary movement is also adapted to be raised and lowered for the purpose of picking up the trays 89 and depositing them in reverse positions in a following operation of the turn-table, in a manner which will be described hereinafter.

Operating mechanism for turn-table

A vertical rotatable shaft 92 (Figs. 3, 5 and 6) is journaled at its lower end in spaced stationary bearing brackets 93, the upper end thereof extending into the inner chamber 56. Keyed to rotate with the shaft 92, as indicated at 94, but permitting the shaft to be moved longitudinally upwardly and downwardly is a helical gear 95 which is arranged between the stationary brackets 93. Fixed to the upper end of the shaft 92 is a pinion 97 which meshes at diametrically opposite points with a pair of gear racks 98, slidably mounted in the turn-table frame 86 and connected to the slides 87. Upon the shaft 92 being rotated the slides 87 will be moved to an extended position or moved to a retracted position on the frame 86, depending upon the direction of rotation of the shaft. Surrounding the shaft 92 at its upper end is a rotatable sleeve 99 to which the turn-table 85 is secured for rotation therewith. The sleeve 99 is rotatable and longitudinally slidable in a bearing 100 equipped with a stuffing gland 101 which serves to effect an air-tight seal for the chamber 56 at this point. Surrounding and fixed to the sleeve 99 is a clutch element 104 to the upper end of which is secured a disc 105, the lower end of the element having clutch teeth. The disc 105 is provided with a pair of diametrically opposite peripheral notches 106 and cam plates 108 (Figs. 3 and 6) secured to its undersurface, which will be referred to hereinafter, the cam plates being predeterminedly spaced angularly from the notches. Rotatably carried at its upper end upon the clutch element 104, as indicated at 111 (Fig. 5), and at its lower end of the point 112 upon the shaft 92, is a member 113 with a bifurcated portion 114, the clutch element 104 and the shaft 92 being free to rotate relative to the member 113. A clutch element 115 provided with clutch teeth at each end is slidably mounted on the shaft 92 but keyed thereto, as indicated at 116, so that the clutch element 115 is rotatable with the shaft at all times. Freely mounted on the shaft 92 below the clutch element 115 and capable of rotary and longitudinal movement on the shaft is a clutch element 117 formed with clutch teeth at its upper end and upon its periphery with a pinion 118. The clutch element 117 at its lower end is supported on the lower portion of the member 113 so that when the member is moved up or down the clutch element will follow.

A lever 119 formed with bifurcated ends is pivoted at 120, the furcations at its right end (Figs. 3, 5 and 6) being pivoted to the furcations of the portion 114 of the member 113, and the furcations

at its left end being pivoted to a nut 121 (Figs. 3 and 6) threadedly engaging a vertical rotatable screw 122. A bevel gear 125 is fixed to the screw 122 and opposite ends of the screw are rotatably journaled in stationary brackets 126 in such a manner that the screw will not move longitudinally. Meshing with the bevel gear 125 is a similar gear 127 which is connected to a rotary hand wheel 128 journaled upon and arranged outside of the housing of the work transfer unit 55. Upon the hand wheel 128 being rotated the screw 122 will also be rotated and through the meshing gears 125 and 127 the nut 121 will be caused to travel upwardly or downwardly upon the screw, depending upon the direction of rotattion of the hand wheel, thus causing the lever 119 to be rocked about its pivot and thereby elevating or lowering the member 113 and with it the sleeve 99, shaft 92, clutch elements 104, 115, and 117, and the turn-table 85. Suspended from the lever 119 at a point adjacent the nut 121 are weights 130 which serve to counterbalance the weight of the turn-table 85 and connected elements and the work being transferred.

The clutch element 115 may be shifted upwardly upon the shaft 92 to which it is rotatably fixed by a bifurcated lever 131 pivoted to the member 113 (Figs. 3 and 6), the furcations of the lever carrying pins 132 which engage in a peripheral channel formed in the clutch element. The lever 131 which is positioned below the lever 119 and extends at an angle to the latter lever has its furcations disposed within the furcations of the lever 119 and is pivoted between the walls of a vertical slot 133 (Fig. 6) of the member 113 by a pin 134. Operatively connected to the lever 131 by a vertical link 135 is a hand lever 136 which extends outside of the housing of the unit 55, the link being pivotally connected to the levers at 139 and 140 and the lever 138 is pivoted at 141 (Fig. 6) to the housing. When the hand lever 138 is raised or rocked clockwise about its pivot, the clutch element 115 will be shifted upwardly to disengage its lower teeth from the clutch element 117 and engage its upper teeth with the clutch element 104. This, it will be apparent, may be effected when the member 113 is either in its lower or upper position.

Slidably mounted in a boss 142 formed on the member 113 (Figs. 3 and 6) is a longitudinally slidable spring pressed plunger 143 which at its upper end, as shown in the position of the parts in Figs. 3 and 6, is entered in one of the notches 106 of the disc 105. When the plunger 143 is entered in one of the notches 106 it will be apparent that the turn-table 85 cannot be rotated from the shaft 92. The plunger 143 is normally held in its upper position by a compression spring 144 surrounding the plunger with its opposite ends abutting the upper surface of the boss 142 and a collar 145 fixed to the plunger. A pin 146 fixed to the plunger 143 is entered at opposite ends in suitable slots provided in opposite portions of the lever 131, the plunger extending between the lever portions. When the hand lever 138 is raised the clutch element 115 is shifted upwardly through the lever 131, and the shaft 92 and the sleeve 99 are rotatably connected together, thus completing the rotary drive to the turn-table 85. At this instant the movement of the lever 131 which is counterclockwise and connected to the plunger 143 by the pin 146 moves the plunger downwardly, compressing the spring 144 and withdrawing its upper end from the cooperating notch 106 of the disc 105, thus unlocking the turn-table 85 so that it may be rotated. Meshing with the pinion 116 on the clutch element 117 is a gear 148 rotatably mounted as indicated at 149 on the member 113. Formed in the upper surface of the gear 148 is an aperture 150 for receiving the lower end of the plunger 143 when it is moved downwardly as above described, the gear at this instant being positioned so that the aperture is alined with the plunger. The gear 148 is formed with a downwardly extending flange 151 provided with a vertical slot 153 spaced a predetermined angular distance from the aperture 150.

Fixed to the lever 119 is a depending arm 154 having a vertical finger 155 at its lower end which is arranged to enter the slot 153 of the gear flange 151 and pass within the inner periphery thereof when the lever is rocked counterclockwise by means of the hand wheel 128, the slot at this time being alined with the finger. The gear 148 in subsequent operations during which the slides 87 are being extended or retracted is rotated and the slot 153 is thereby moved out of alinement with the finger 155 attached to the lever 119, thereby interlocking the finger behind the inner periphery of the gear flange 151, which thereby prevents the lowering of the turn-table 85, since the lever cannot be rocked clockwise about its pivot. When the finger 155 is positioned outside the periphery of the gear flange 151, as shown in Figs. 3 and 7, and the gear slot 153 has been moved out of alinement with the finger, the lever 119 cannot be rocked counterclockwise about its pivot, and thus the elevation of the turn-table 85 is prevented during operations in which the slides 87 are being extended or retracted.

Simultaneously with the above described disalinement of the gear slot 153 and the finger 155 the gear aperture 150 will be moved out of alinement with the plunger 143, which serves to prevent the rotation of the turn-table 85 during operations in which the slides 87 are being extended or retracted. When the slides 87 are partially extended or retracted the plunger 143 will be in its upper position and the lower end thereof will lie close to the upper surface of the gear 148, with the result that if an attempt is made at this time to raise the lever 138 to engage the clutches 115 and 104, the plunger will engage the upper surface of the gear which acts as a stop.

The shaft 92 is rotated from a hand wheel 156 arranged alongside of the hand wheel 128 through a shaft 157 carrying a helical pinion 158 which meshes with the helical gear 95 keyed to the shaft 92, the shaft 157 being suitably journaled at opposite ends in bearing brackets.

For opening and closing the inner door 58 there is provided a hand wheel 159 fixed to a horizontal shaft 160 (Figs. 5 and 6), the hand wheel being arranged alongside of the hand wheel 156. Rotary motion from the shaft 160 is transmitted to a vertical shaft 161 through bevel gears 162 and thence to a horizontal shaft 163 (Figs. 3 and 6) arranged at right angles to the shaft 160 by means of bevel gears 165, the shafts 160, 161, and 163 being journaled in suitable bearing brackets. Fixed to the shaft 163 is a worm 167 which meshes with a worm gear sector 168 (Fig. 3) secured to the shaft 64 supporting the arm 63 which carries the door 58.

Slidably mounted in a stationary U-shaped bracket arranged below the disc 105 with its upper end extending into the path of the cam plates

168 is a spring pressed plunger 171 (Figs. 5 and 6), a spring 172 surrounding the plunger and having its opposite ends abutting a collar 173 fixed to the plunger and an arm of the bracket normally maintains the plunger in its upper position. A lever 174 pivoted at 175 and provided with an aperture at its left end is operatively associated with the upper end of the plunger 171 which extends through the aperture, the plunger carrying a pin 176 engaging the upper surface of the lever. At its right end the lever 174 is formed with a latch 179 for engaging a notch in a collar 180 fixed to the shaft 160. A tension spring 181 attached to the lever 174, adjacent the latch 179, in cooperation with the spring 172, normally retains the latch in locking engagement with the notched collar 180 and when thus engaged the shaft 160 is locked from rotation, thereby preventing the inner door 58 from being lowered with the mechanism, as shown in Figs. 3, 5 and 6. When the plunger 171 is pressed downwardly by one or the other of the cam plates 108 moving into engagement therewith, the lever is rocked counterclockwise and the latch 179 is withdrawn, thus permitting the inner door 58 to be closed by rotating the hand wheel 159.

When the inner door 58 is closed as shown in Fig. 4 the hand wheel 156 is locked from rotation, so that the turn-table 85 cannot be rotated or elevated. This is effected by means of a latch 182 (Figs. 3 and 6) slidably mounted in a bracket supporting the helical pinion 158. A compression spring 183 surrounding the latch 182 and abutting at opposite ends against a collar fixed to the latch and a stationary guide, through which the latch extends, normally acts to maintain the latch in locking engagement between adjacent teeth of the pinion 158. Carried by the gear sector 168, included in the mechanism for opening and closing the inner door 58, is a cam member 184 (Fig. 3) which during the opening of the door moves into engagement with a roller 187 mounted on a vertically slidable bar 188, the latch 182 and the bar being connected together by a link 189 pivotally connected at opposite ends thereto. As the inner door 58 reaches its open position, indicated in dotted outline in Fig. 4, the latch 182 is withdrawn from locking engagement with the pinion 158 to the position shown in Fig. 3.

The circuit to the motor (not shown) which drives the annular hearth 26 includes a switch 190 (Fig. 5), which is actuated to open and close the circuit to the motor by the plunger 171, independently of the timing mechanism (not shown), hereinbefore referred to in connection with the step by step rotation of the hearth, to insure that the hearth will not rotate during the discharging and charging operation. When the plunger 171 is moved to its upper position, as shown in Figs. 5 and 6, through the action of the spring 172, the circuit to the motor will be opened and the rotary hearth 26 will remain stationary, and when it is depressed by one or the other of the cam plates 108 moving into engagement therewith at the completion of the work charging and discharging operation, the circuit to the motor is prepared for final closing by the operator actuating the starting button, hereinbefore mentioned in connection with the timing mechanism (not shown) associated with the driving mechanism for the hearth. It will also be apparent that when the turn-table 85 and the attached disc 105 are in their elevated position during certain steps in the operation of the work transfer unit 55, the cam plates 108 carried by the disc will move idly by the plunger 171 and the latter will consequently remain in its upper open circuit position.

Baffle for heating chamber

A baffle indicated in general at 192 (Figs. 1, 2, 3 and 5) effectively prevents the egress of hot hydrogen gases from the heating chamber 16 into the inner chamber 56 through the furnace opening 47, at all times, except during the charging and discharging of work into and from the furnace. The baffle 192 comprises a base plate 193 surrounding the turn-table 85 below the frame 86 thereof and supported on a floor 194 of the inner chamber 56. Fixed to the base plate 193 is a pair of diametrically opposite sockets 195 for freely receiving the lower ends of pins 196, secured to opposite sides of the turn-table frame 86, when the latter is in its lowered position as shown in Figs. 1, 3 and 4. As thus connected to the turn-table frame 86 the baffle 192 may be rotated with the turn-table during certain steps in the charging and discharging of work into and from the furnace and upon the turn-table being elevated and rotated during other operating steps, the pins 196 at this time having been withdrawn from the sockets 195, the baffle will remain stationary. At its right end, as shown in Fig. 3, wherein the baffle 192 is shown positioned away from the furnace opening 47, the plate 193 which is arc-shaped carries a vertical member 197, similarly shaped, having its opposite vertical edges at their upper ends connected together with a stiffening plate 198 (Fig. 1). The total height of the vertical member 197 and the plates 193 and 198 is such that they closely fit within the height of the opening in the housing of the mechanism 55 where it joins the opening 47 but may be freely moved therein. Fixed to the opposite vertical walls of the housing of the mechanism 55 at the opening 47 (Fig. 1) are filler plates 199 which are turned inwardly at their inner ends and directed toward the opening 47.

Operating cycle

In the operation of the herein described furnace and air lock and work transfer mechanism 55, let it be assumed that the turn-table 85 is in a quiescent position, as shown in Fig. 4, in which position the baffle 192 intermittently rotatable therewith, has closed the opening 47 into the heating chamber 16 to prevent the egress of hot hydrogen gas therefrom into the inner chamber 56, the inner door 58 being in a closed position, a tray 89 of material to be charged onto the hearth 26 has been predeterminedly positioned on the floor 91 of the outer chamber 57, the outer door 59 of which has been manually closed, and the rotatable hearth 26 is at rest during one of its stationary periods with a tray 89 of heat treated material centered with the furnace opening 47 and alined with the turn-table 85 ready for discharge. It is also assumed at this time that the outer chamber 57 has been exhausted of air and then filled with hydrogen gas, in a manner to be described hereinafter. Starting with the furnace and the mechanism 55 conditioned as just described a complete cycle of operation of the mechanism to insert the tray 89 of material to be treated into the furnace from the floor 91 of the outer chamber 57 and to remove a tray 89 of treated material from the furnace, which latter tray is stationary and alined with the opening 47 and the turn-table

85, and deposit it upon the floor of the outer chamber is as follows:

In the quiescent position of the turn-table 85 (Fig. 4) the upper end of the spring pressed interlocking plunger 143 has been withdrawn from one of the notches 106 of the disc 105 and is abutting the under surface of the disc and the lower end thereof is entered in the aperture 150 of the gear 148, and the finger 155 carried by the lever 119 is alined with the slot 153 of the flange 151 of the gear 148 and is positioned outside the periphery of the flange. Also with the plunger 143 in its lower position the clutch element 115 is maintained in its upper position in engagement with the clutch element 104 by means of the connection between the plunger and the lever 131. It is also to be understood that the latch 179 has been withdrawn from the notched collar 180 on the shaft 160 so that the hand wheel 159 is free to be rotated to open the inner door 58. The described positions of the plunger 143 and the latch 179 were effected automatically at the completion of the last work transfer operation and will be further described upon completion of the cycle of operation being described. The operator now opens the inner door 58 to the dotted position thereof, shown in Fig. 4, by rotating the hand wheel 159 clockwise, which withdraws the latch 182 from locking engagement with the teeth of the pinion 158, thus freeing the hand wheel 156 and permitting the turn-table 85 to be rotated. The hand wheel 156 is now rotated counterclockwise, which causes a clockwise rotation of the turn-table 85, the rotation continuing 90° until one of the notches 106 of the disc 105 spaced at this time 90° from the plunger 143 is moved into alinement with the plunger, which immediately springs into the notch and thus prevents further rotation of the turn-table, the lower end of the plunger being withdrawn from interlocking engagement with the gear 148, which is now free to be rotated. The operating elements of the work transfer mechanism 55 have now been operated to the positions thereof as shown in Figs. 1, 3, 5 and 6. Simultaneously with this movement of the plunger 143, the clutch element 115 returns to its lower position in engagement with the clutch element 117, through the action of the spring 146, pulling the plunger upwardly, which by means of its connection with the lever 131, which is rocked clockwise, moves the clutch element downwardly. At the beginning of the 90° rotation of the turn-table 85 one of the cam plates 108 carried by the disc 105 and which has been operatively engaged with the spring pressed plunger 171 moves away and the plunger immediately moves upwardly and actuates the switch 190, thereby insuring that the circuit to the motor will remain open during the operation of the transfer mechanism 55 and the rotary hearth 26 remain stationary.

The slides 87 of the turn-table 85 are now simultaneously extended into the heating chamber 16 and outer chamber 57 and into the openings 99 of the trays 89, which are alined in the two chambers, by rotating the hand wheel 156 counterclockwise and thereby through the mechanism previously described the racks 98 attached to the slides are moved outwardly. During this outward movement of the slides 87 the shaft 92 was rotated clockwise and through the clutch element 115 engaged with the clutch element 117 carrying the pinion 118, the gear 148 is rotated counterclockwise. Thus the gear slot 153 is moved out of alinement with the finger 155, which is positioned outside the periphery of the gear flange 151, thereby preventing the raising of the turn-table 85 during the extension of the slides 87. At the termination of this rotation of the gear 148, or when the slides 87 are fully extended, the slot 153 will again be alined with the interlocking finger 155 and the gear aperture 150 will also be alined with the plunger 143. The turn-table 85 is now elevated to pick up the trays 89 in preparation for a 180° rotation of the turn-table to transfer the tray which is in the outer chamber 57 to the heating chamber 16 and the tray in the latter chamber to the outer chamber. To elevate the turn-table 85 the hand wheel 128 is rotated clockwise, which rocks the lever 119 counterclockwise and thereby moving upwardly, as a unit, all of the elements surrounding the shaft 92 which are positioned above the lower end of the member 113. During this movement of the lever 119 the interlocking finger 155 is rocked into the gear slot 153 and within the inner periphery of the flange of the gear, but no locking of the finger to the gear takes place until the gear is again rotated during a retraction of the slides 87 from their extended positions. The turn-table 85 is held in its upper position, with the trays 89 supported thereon, by the cooperating nut 121 and the screw 122 associated with the hand wheel 128.

The slides 87 carrying the trays 89 are now retracted to position them within the inner chamber 56 so that the turn-table 85 may be rotated therein 180° to reverse the position of the trays. To retract the slides 87 the hand wheel 156 is rotated clockwise, the racks 98 with the attached slides being moved inwardly. This rotation of the hand wheel 156 also through the rotation of the clutch element 115 rotates the clutch element 117 carrying the pinion 118, which in turn rotates the gear 148 clockwise to again aline the gear aperture 150 with the plunger 143 and also the gear slot 153 with the interlocking finger 155. The disengagement of the clutch element 115 from the clutch element 117 during the retraction of the slides 87 by a raising of the hand lever 138 is prevented by the lower end of the plunger 143, which during this time is out of alinement with the gear aperture 150, and is engaging the upper surface of the gear 148. Thus a premature rotation of the turn table 85 with the slides 87 in a partially retracted position is avoided. This same result is obtained by the disalinement of the plunger 143 and the gear aperture 150 during the extension of the slides 87.

With the slides 87 in a fully retracted position the turn-table 85 is rotated clockwise 180°. This is effected by first raising the hand lever 138 which moves the clutch element 115 upwardly and operatively connects the shaft 92 to the turn-table. Simultaneously with this movement of the clutch element 115, the lever 131 at its left end is rocked downwardly and through its connection to the plunger 143 by means of the pin 146 and the slots of the plunger and the lever, respectively, the plunger is moved downwardly. The upper end of the plunger 143 is thus withdrawn from the notch 106 of the disc 105, thereby unlocking the turn-table 85 for rotation, the plunger at its lower end entering the aperture 150 of the gear 148 and locking the gear from rotation, the aperture being previously alined with the plunger at the termination of the retraction of the slides 87.

The purpose of locking the gear from rotation and thereby the clutch element 117, which occurs whenever the clutch element 115 is disengaged from the clutch element 117 is to maintain the position of the latter clutch element so that when the clutch element 115 is lowered to engage the clutch element 117 the teeth of the clutch elements will accurately register in driving engagement. The hand wheel 156 is now rotated counterclockwise, while momentarily holding the hand lever 138, still in a raised position, until the notch 106 of the disc 105, from which the plunger 143 was withdrawn, is moved out of alinement therewith and engages the under surface of the disc. The rotation of the hand wheel 156 is continued until the other notch 106 which is spaced 180° from the notch from which the plunger 143 was last withdrawn is moved into alinement with the plunger, which immediately springs into the notch and thus prevents further rotation of the turn-table 85, the plunger at its lower end being withdrawn from interlocking engagement with the gear aperture 150. In a manner similar to that described in connection with the 90° rotation of the turn-table 85 the clutch element 115 returns to its lower position as shown in Figs. 3 and 5.

The position of the trays 89 have now been reversed by a 180° clockwise rotation of the turn-table 85 within the inner chamber 56 and are ready to be inserted in the heating chamber 16 and the outer chamber 57 by the slides 87 being extended on the locked and still elevated turn-table. The hand wheel 156 is now rotated in a counterclockwise direction which, in a manner similar to that described in connection with the previous extension of the slides 87 in preparation for picking up the trays 89 from the rotary hearth 26 and the floor 91 of the outer chamber 57 causes the slides to be extended into the chambers 16 and 57 and rotates the gear 148 counterclockwise, the gear slot 153 at the termination of the extension of the slides being again alined with the interlocking finger 155 carried by the lever 119. The turn-table 85 is now free to be lowered by means of the hand wheel 128. The finger 155 during this rotation of the gear 148 is still within the inner periphery of the flange 151 of the gear so that a lowering of the turn-table 85 during the extension of the slides 87 is prevented. Also during this rotation of the gear 148 the aperture 150 thereof moves out of alinement with the plunger 143 so that the plunger lies over the upper surface of the gear to prevent, as described hereinbefore, a premature rotation of the turn-table 85 while the slides are in a partially extended position during the retraction thereof.

With the slides 87 extended the tray 89 of material to be heat treated is positioned in the chamber 16 over the still stationary hearth 26 and the tray of treated material is in the outer chamber 57. The turn-table 85 is now lowered to deposit the reversed trays 89 on the hearth 26 and the floor 91 of the outer chamber 57 by rotating the hand wheel 128 counterclockwise which is opposite to its direction of rotation in elevating the turn-table, as previously described. During this operation all of the elements previously mentioned in connection with the elevation of the turn-table are lowered, as a unit, to the position shown in Figs. 3 and 5. Also at this time the interlocking finger 155 is withdrawn from the alined slot 153 of the gear 148 and to the position shown in Figs. 3 and 7. Following this the slides 87 are retracted into the inner chamber 56 by a clockwise rotation of the hand wheel 156, similar to the operation of retracting the slides when they were carrying the trays from the hearth and outer chambers 16 and 57, respectively, into the inner chamber 56. Simultaneously with the retraction of the slides 87 the gear 148 is rotated clockwise to move the gear slot 153 out of alinement with the interlocking finger 155, which at this time is in the position shown in Figs. 3 and 7 adjacent the outer peripheral surfaces of the flange of the gear 148, thereby preventing the elevation of the turn-table 85 during the retraction of the slides 87. It will be apparent that with the finger 155 adjacent the outer peripheral surface of the flange of the gear 148 with the slot 153 thereof out of alinement therewith, the lever 119 which carries the finger cannot be rocked to elevate the turn-table. This last mentioned rotation of the gear 148 also moves the aperture 150 thereof again into alinement with the plunger 143 at the termination of the retraction of the slides 87.

To complete the cycle of operations the turn-table 85 is now rotated counterclockwise 90° to a quiescent position as shown in Fig. 4. The rotation of the turn-table 85 up to this point in the cycle of operations has been in a clockwise direction. This final 90° rotation in a counterclockwise direction of the turn-table 85 is for the purpose of moving the baffle 192 to close the furnace opening 47. The operation of the baffle 192 will be described hereinafter. This 90° rotation of the turn-table 85 is accomplished by first raising the hand lever 138 to actuate the operatively connected parts, followed by a clockwise rotation of the hand wheel 156, in a manner similar to that described in connection with the raising of the lever and the rotation of the hand wheel for the 180° rotation of the turn-table 85, with the exception that the rotation of the turn-table by means of the hand wheel 156 is continued only until the turn-table is positioned as shown in Fig. 4, wherein it is positioned at right angles to its position as shown in Figs. 1, 3 and 5. During this rotation of the turn-table 85 the plunger 143 which has been withdrawn from one of the notches 106 of the disc 105 is abutting the under surface of the disc and the lower end thereof is entered in the gear aperture 150, the turn-table thus being free to be rotated in the next work transfer operation. To facilitate the positioning of the turn-table 85, as just described, the side wall of the inner chamber 56 where the operator stands when manipulating the various hand wheels and the lever is provided with a glass window 200 (Figs. 1 and 3), which permits the operator to view the rotation of the turn-table. Upon the completion of this 90° rotation of the turn-table 85 one of the cam plates 108 carried by the disc 105 moves into engagement with the plunger 171, depressing it and thereby preparing the motor circuit at this point for closing by means of the starting button, which may then be actuated to start the annular hearth 26 rotating. Simultaneously with this movement of the plunger 171 the latch 179 of the lever 174 is withdrawn from the notch of the collar 180, which permits the operator to close the inner door 58 by rotating the hand wheel 159. The closing of the inner door 58 permits the latch 182 to move into locking engagement with the teeth of the pinion 158, thus locking the hand wheel 156 from rotation and thereby preventing the turn-table 85 from being rotated or elevated when the inner door is closed. Since the switch

190 has been actuated to close the motor circuit for rotating the hearth 26 when the turn-table 85 is in its lowered quiescent position it will be apparent that by locking the hand wheel 156 the accidental elevation of the turn-table at this time is positively prevented. With the inner door 58 closed the latch 79 has been drawn from locking engagement with the keeper 83 on the outer door 59, which may then be opened and another tray 89 of material to be heat treated is inserted in the outer chamber 57 in preparation for the next work transfer operation. It is to be understood that before opening the outer door 59 to remove the treated material the hydrogen gas is exhausted from the chamber 57 through an outlet 201 (Figs. 1 and 4) which may be connected to a vacuum pump (not shown). The outer door 59 is then manually closed and secured by the hand screw 72 and the catch 76 and thereafter the air is exhausted from the outer chamber 57 through the outlet 201, in a manner similar to that described in connection with the exhausting of the hydrogen gas therefrom and thereafter hydrogen gas is admitted through an inlet 202 connected to a source of supply, which also supplies the heating chamber 16, the outlet and the inlet being controlled by hand valves (not shown).

Operation of baffle

In the operation of the air lock and work transfer mechanism just described the baffle 192 is operated as follows: In the quiescent position of the turn-table 85 (Fig. 4), wherein it is in its lowered position, the pins 196 are engaged in the sockets 195 of the baffle 192, the latter being in position to close the furnace opening 47. In the initial clockwise 90° rotation of the turn-table 85 the baffle 192 is rotated therewith to the position shown in Figs. 1, 3, and 5. Following this, the slides 87 are extended and then the turn-table 85 is elevated, which elevation withdraws the pins 196 from the sockets 195 of the baffle. The slides 87 are thereafter retracted. During the 180° rotation of the turn-table 85, which follows, the baffle 192 remains stationary. Thereafter the slides 87 are extended, which is followed by the lowering of the turn-table 85 which enters the pins 196 carried thereby into the sockets 195 of the baffle 192, thus again connecting the baffle to the turn-table so that in the final 90° rotation of the turn-table to its quiescent position, which is in a counterclockwise direction, the baffle will be moved to again close the furnace opening 47.

It is believed that the advantages of the present invention will be clearly apparent from the above detailed description of construction and operation. The described construction provides a very efficient electrically heated rotary hearth hydrogen gas furnace.

Although the invention as herein illustrated and described is particularly applicable to furnaces of the character above described, it should be understood that the novel features of the invention are capable of other applications within the scope of the appended claims.

What is claimed is:

1. In a charging mechanism adapted for use with a furnace, a rotatable element having a plurality of members extensible therefrom in opposite directions for supporting articles, and means for actuating said extensible members.

2. In a charging mechanism adapted for use with a furnace, a rotatable element having a plurality of members arranged in a common plane and extensible therefrom at opposite points for supporting articles, and means for actuating said extensible members.

3. In a charging mechanism adapted for use with a furnace, a rotatable and vertically reciprocable element having a plurality of members extensible therefrom for supporting articles, means for extending and retracting said members to position them under and withdrawing them from the articles, means for elevating said element and the extended members when the articles are supported thereon, and means for rotating said element when said extensible members carrying the articles have been drawn inwardly to reverse the position of the articles.

4. In a charging mechanism adapted for use with a material treating furnace having a charging and discharging opening, a rotatable baffle at the furnace opening to close the same except when the furnace is being charged and discharged, a charging mechanism operable for charging untreated material into the furnace and discharging treated material from the furnace during an operating cycle, operative connections between said mechanism and said baffle cooperating to cause the baffle to be moved from the furnace opening during an initial portion of the operating cycle of said mechanism, said operative connections permitting said baffle to be automatically disconnected from the mechanism and remain stationary during an intermediate portion of the operating cycle and during a final portion thereof to be automatically connected to said mechanism and moved to close the furnace opening, and means for operating said charging mechanism to complete a cycle of operations.

5. In a charging mechanism adapted for use with a hydrogen material treating furnace having a charging and discharging opening, an air lock at the furnace opening comprising inner and outer chambers, means operable in said inner chamber for charging material through said air lock into the furnace, an inner door between said chambers, an outer door for said outer chamber, actuating means for said inner door, and interlocking means operatively associated with said door responsive to an opening of said inner door for locking said outer door from being opened after closure until said inner door is again closed.

6. In a charging mechanism adapted for use with a hydrogen material treating furnace having a charging and discharging opening, an air lock at the furnace opening comprising inner and outer chambers, an inner door between said chambers, an outer door for said outer chamber, actuating means for said inner door, a keeper fixed to an inner surface of said outer door, and interlocking means disposed between said doors comprising a pivotal lever having a latch at one end operatively engageable with said keeper in one position of said lever, the opposite end of said lever positioned in the path of and operatively engaged by said inner door, and means constantly urging said lever to move to operatively engage said keeper, said interlocking means responsive to an opening of said inner door for locking said outer door from being opened after closure until said inner door is again closed.

7. In a charging mechanism adapted for use with a furnace, a reciprocable element having a plurality of members extensible therefrom for supporting articles, actuating means for extending and retracting said members, means for actuating said element with the members extended or retracted, and interlocking means operatively

associated with said means for extending and retracting said members and said means for moving said element responsive to an actuation of said former means for locking said latter means from actuation so that said element cannot be moved while said members are being extended or retracted.

8. In a charging mechanism adapted for use with a furnace, a vertically reciprocable element having a plurality of members extensible therefrom for supporting articles, actuating means for extending and retracting said members, actuating means for elevating and lowering said element with said members extended or retracted, and interlocking means operatively associated with said means for extending and retracting said members and said means for elevating and lowering said element responsive to an actuation of said former means for locking said latter means from actuation so that said element cannot to be elevated or lowered while said members are being extended or retracted.

9. In a charging mechanism adapted for use with a furnace, a rotatable element having a plurality of members extensible therefrom for supporting articles, actuating means for extending and retracting said members, actuating means for rotating said element with the members extended or retracted, and interlocking means operatively associated with said means for extending and retracting said members and said means for rotating said element responsive to an actuation of said former means for locking said latter means from actuation so that said element cannot be rotated while said members are being extended or retracted.

10. In a charging mechanism adapted for use with a furnace, a rotatable element having a plurality of members extensible therefrom for supporting articles, actuating mechanism for extending and retracting said members, actuating means for rotating said element including a clutch mechanism, means for actuating said clutch mechanism, means operatively connected to said actuating mechanism for said members and movable during an extension or retraction of said members to predeterminedly position a stop surface thereof, and a stop element carried by said clutch actuating means and movable during an actuation thereof into abutting relation with said stop surface to render said clutch actuating means inoperative to cause a rotation of said element during an extension or retraction of said members.

11. In a charging mechanism adapted for use with a furnace, an air lock at the furnace opening comprising inner and outer chambers, an inner door between said chambers, an outer door for said outer chamber, means operable in said inner chamber for charging material through said air lock into the furnace, individual means for actuating said inner door and said charging means, and interlocking means operatively associated with said individual actuating means and controlled by said means for actuating said charging means for rendering said means for actuating said inner door inoperative to close said door during the actuation of said charging means.

12. In a charging mechanism adapted for use with a furnace, an air lock at the furnace opening comprising inner and outer chambers, an inner door between said chambers, an outer door for said outer chamber, means operable in said inner chamber for charging material through said air lock into the furnace, individual means for actuating said inner door and said charging means, and interlocking means operatively associated with said individual actuating means and controlled by said means for actuating said inner door for rendering said means for actuating said charging means inoperative while said inner door is closed.

13. In a charging mechanism adapted for use with a furnace having a movable hearth, a rotatable element having oppositely movable means thereon for supporting articles to be positioned upon and removed from the hearth, and means for actuating said movable means.

14. In a charging mechanism adapted for use with a furnace having a movable hearth, a rotatable element having a plurality of members extensible therefrom in opposite directions for supporting articles to be positioned upon and removed from the hearth, and means for actuating said extensible members.

15. In a charging mechanism adapted for use with a furnace having a rotary annular hearth, a rotatable element having a plurality of members arranged in a common plane and extensible therefrom at opposite points for supporting articles to be positioned upon and removed from the hearth, and means for actuating said extensible members.

16. In a charging mechanism adapted for use with a furnace having a movable hearth and a furnace charging and discharging opening, an air lock at the furnace opening comprising inner and outer chambers, an inner door between said chambers, an outer door for said outer chamber, a rotatable element within the inner chamber having movable means thereon for supporting articles to be positioned upon and removed from the hearth, and means for actuating said movable means.

17. In a charging mechanism adapted for use with a furnace, a rotatable element having a plurality of members extensible therefrom in opposite directions for operative engagement with articles to be entered into and discharged from the furnace, and means for simultaneously actuating said members to operatively engage the articles, retract the members with the articles, rotate said element to reverse the articles, actuate said members to position the reversed articles, and thereafter retract the members from the reversed articles.

18. In a charging mechanism adapted for use with a furnace, a rotatable shaft, a rotatable and vertically reciprocable sleeve surrounding said shaft, said shaft being capable of vertical reciprocation with said sleeve and rotatable independently thereof, a turn table secured to said sleeve for rotation in upper and lower positions of said sleeve, a pinion carried by said shaft within said turn table, racks engaging opposite sides of said pinion and guided horizontally on said turn table, article supporting members carried by said racks for extension under articles to be entered into and discharged from the furnace, means for operatively connecting said sleeve to said shaft whereby said turn table may be rotated in unison with said shaft and upon disconnection said shaft alone being rotatable to extend said article supporting members, and means for reciprocating said sleeve with said shaft and turn table and for rotating said shaft.

19. In a charging mechanism adapted for use with a hydrogen furnace, an air lock at the furnace opening comprising inner and outer chambers, doors for said chambers, a rotatable ele-

ment within said inner chamber, said element having a plurality of members extensible therefrom into said outer chamber and through the furnace opening into the furnace for operative engagement with untreated material in said outer chamber and treated material in the furnace, and means for simultaneously actuating said members to operatively engage the materials, retract the members with the materials into said inner chamber, rotate said element to reverse the materials, actuate said members to enter the reversed materials in the furnace and said outer chamber and thereafter retract the members from the reversed materials and into said inner chamber.

20. In a charging mechanism adapted for use with a hydrogen material treating furnace having a charging and discharging opening, an air lock at the furnace opening comprising inner and outer chambers, a door between said chambers, an outer door for the outer chamber, a horizontally movable baffle within the inner chamber at the furnace opening to close the same except when the furnace is being charged and discharged, a charging mechanism operable for charging untreated material from the outer chamber into the furnace and discharging treated material from the furnace into the outer chamber during an operating cycle, operative connections between said mechanism and said baffle cooperating to cause the baffle to be moved from the furnace opening during an initial portion of the operating cycle of said mechanism, said operative connections permitting said baffle to be automatically disconnected from said mechanism and remain stationary during an intermediate portion of the operating cycle and during a final portion thereof to be automatically connected to said mechanism and moved to close the furnace opening, and means for operating said charging mechanism to complete a cycle of operations.

21. In a charging mechanism adapted for use with a hydrogen material treating furnace having a charging and discharging opening, an air lock at the furnace opening comprising inner and outer chambers, a door between said chambers, an outer door for the outer chamber, a rotatable baffle within the inner chamber at the furnace opening to close the same except when the furnace is being charged and discharged, a charging mechanism comprising a rotatable, vertically reciprocable element having extensible and retractable members operable for charging untreated material from the outer chamber into the furnace and discharging treated material from the furnace into the outer chamber during an operating cycle, operative connections between said element and said baffle cooperating to cause the baffle to be moved from the furnace opening during an initial portion of the operating cycle of said mechanism, said operative connections permitting said baffle to be disconnected from said element by an upward movement of said element and permit it to remain stationary during an intermediate portion of the operating cycle and during a final portion thereof to be moved to close the furnace opening, and means for operating said element and members carried thereby to complete a cycle of operations.

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