Nov. 22, 1932. R. E. TALLEY 1,888,960

CONTINUOUS HARDENING, QUENCHING, AND DRAWING FURNACE

Filed May 13, 1932 6 Sheets-Sheet 1

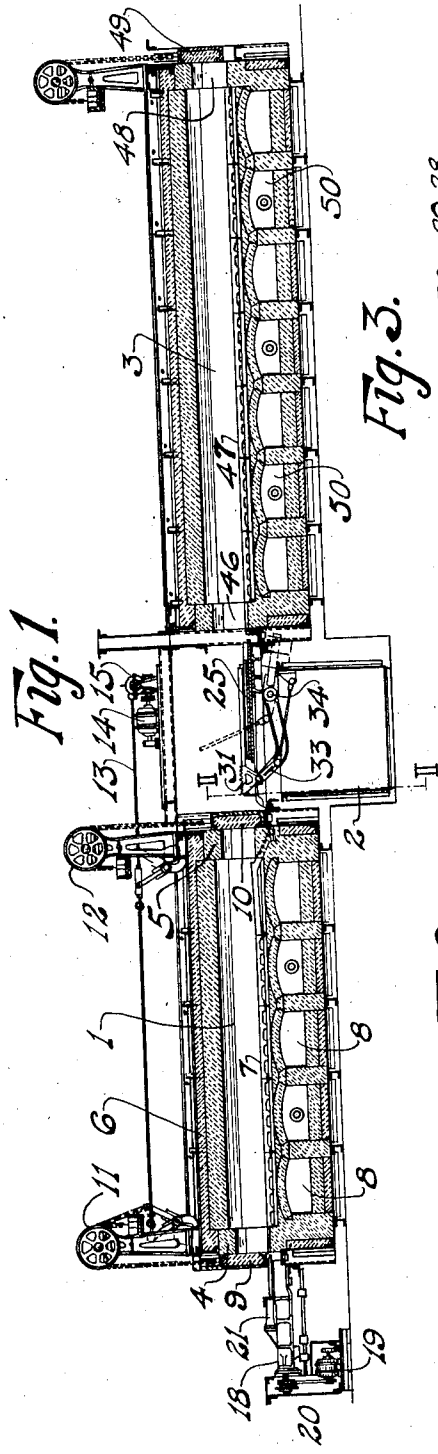


Fig. 1.

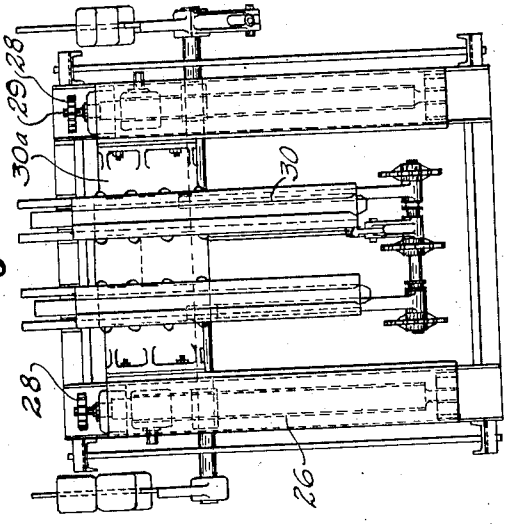


Fig. 3.

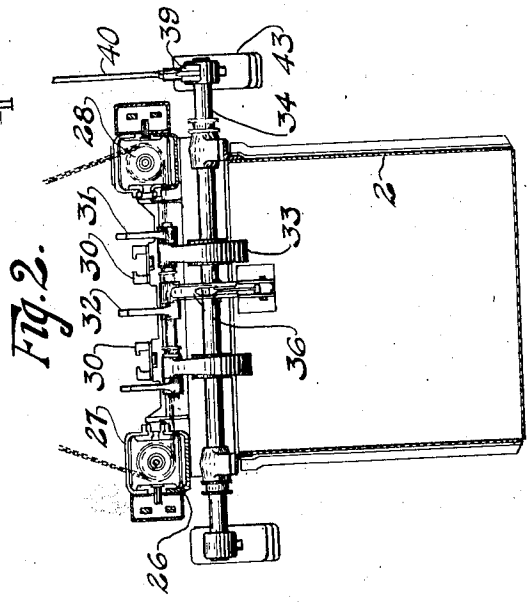


Fig. 2.

INVENTOR
Randal E. Talley
by William B. Jaspert
Attorney

Nov. 22, 1932. R. E. TALLEY 1,888,960

CONTINUOUS HARDENING, QUENCHING, AND DRAWING FURNACE

Filed May 13, 1932 6 Sheets-Sheet 2

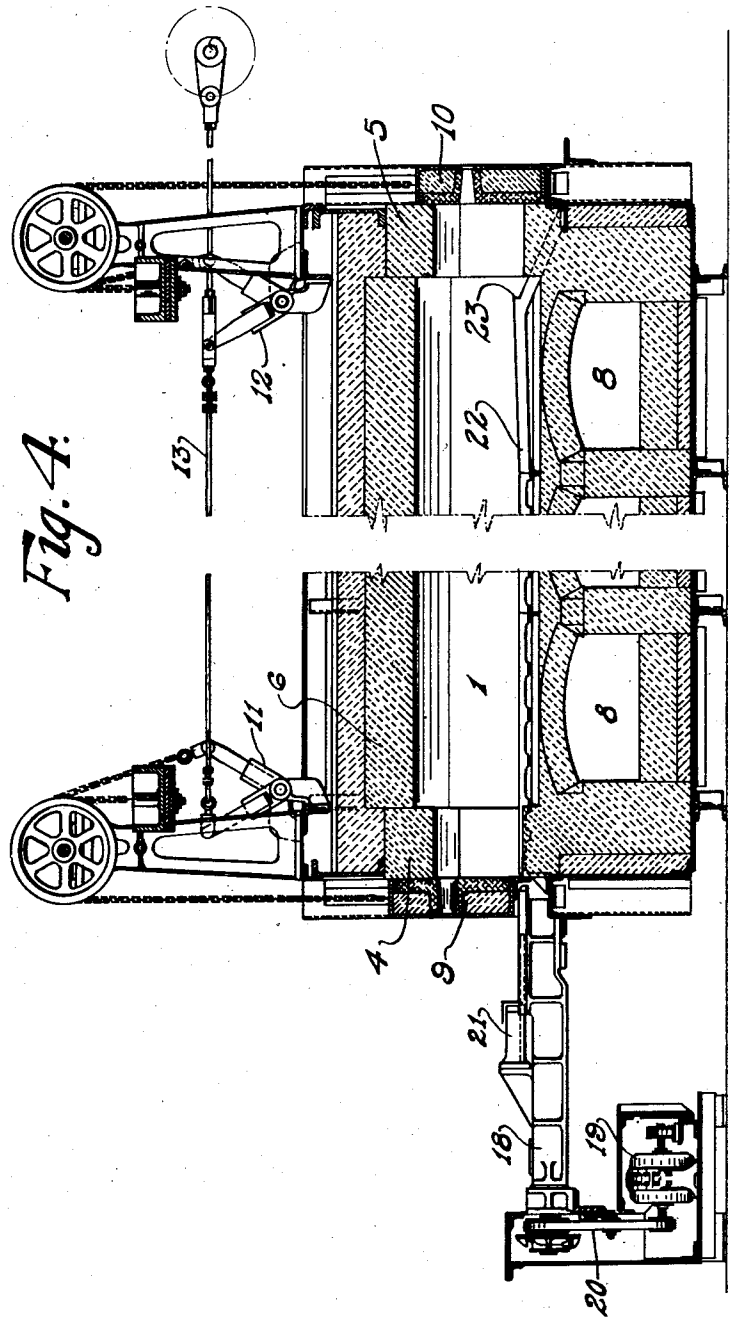


Fig. 4.

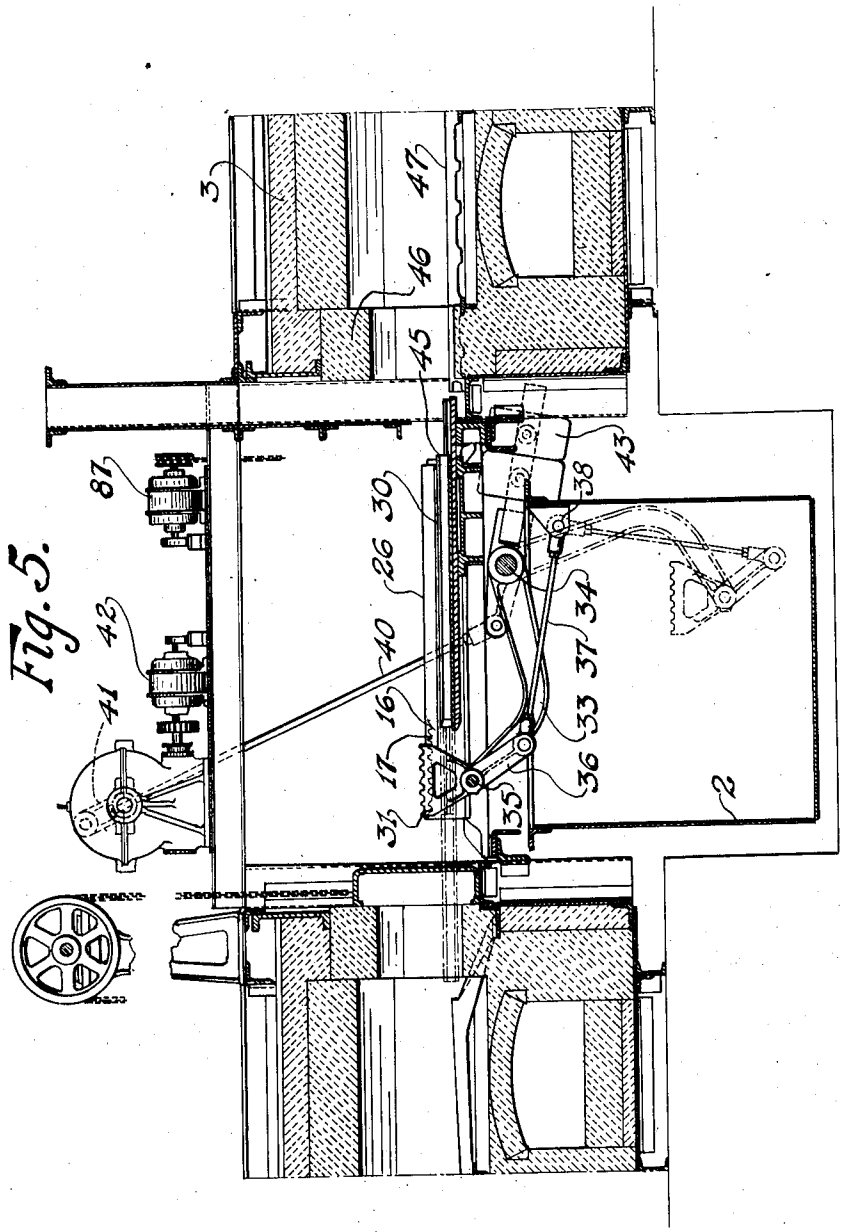
INVENTOR
Randal E. Talley
by William B. Jaspert
Attorney

Nov. 22, 1932. R. E. TALLEY 1,888,960

CONTINUOUS HARDENING, QUENCHING, AND DRAWING FURNACE

Filed May 13, 1932 6 Sheets-Sheet 3

Fig. 5.



INVENTOR
Randal E. Talley
by William B. Jaspert
Attorney

Nov. 22, 1932. R. E. TALLEY 1,888,960

CONTINUOUS HARDENING, QUENCHING, AND DRAWING FURNACE

Filed May 13, 1932 6 Sheets-Sheet 4

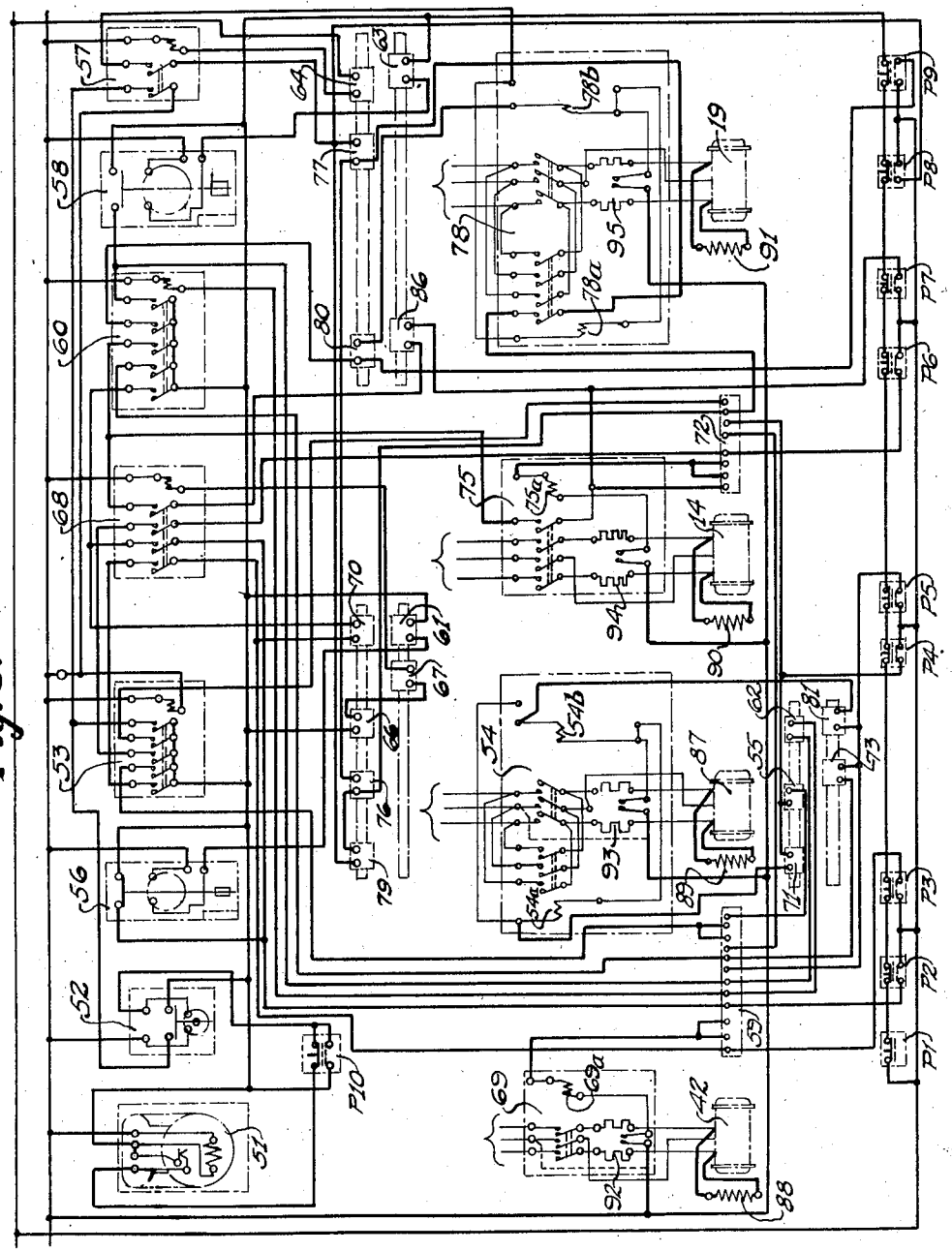


Fig. 6.

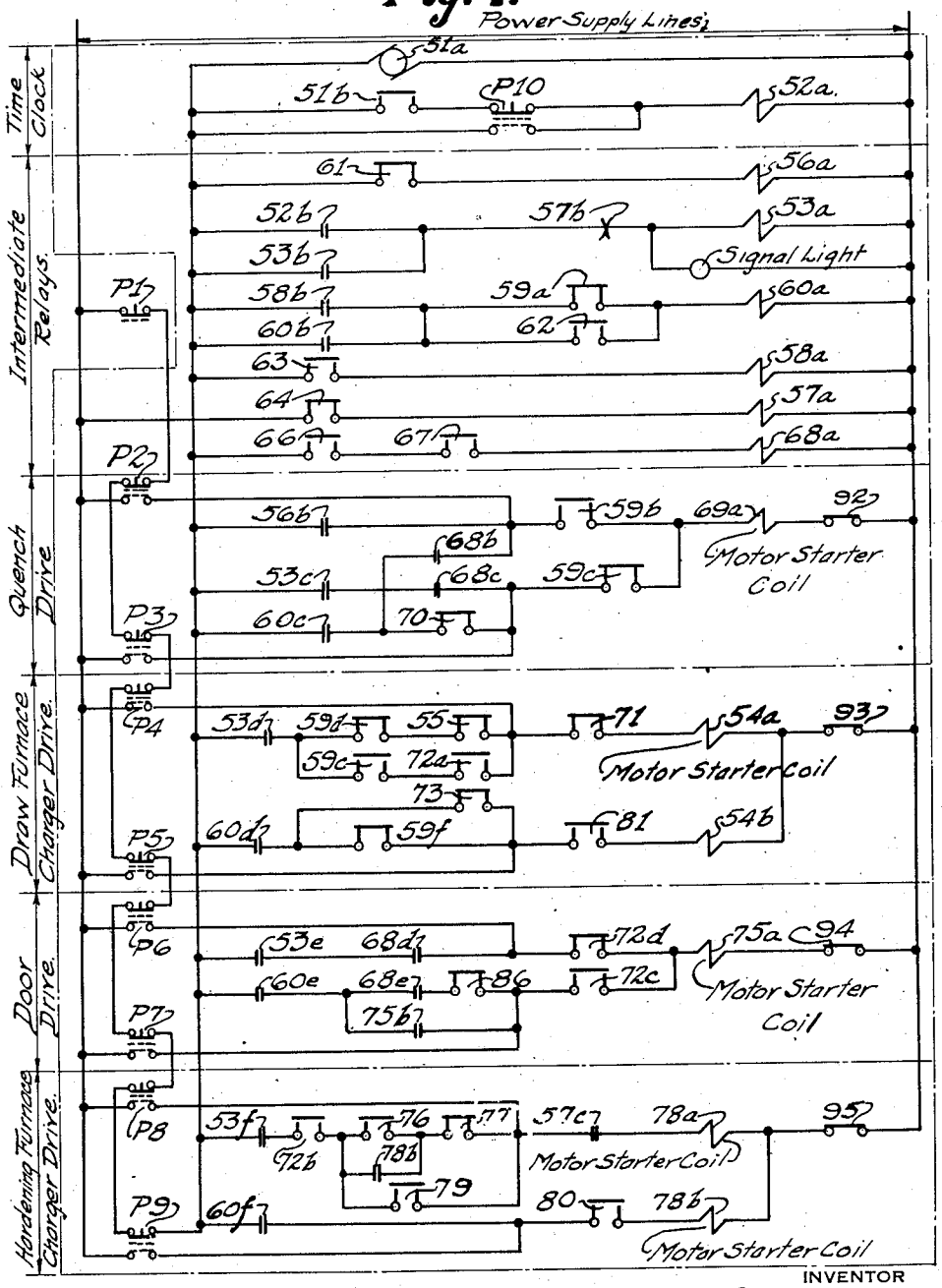
INVENTOR
Randal E. Talley
by William B. Jaspert
Attorney

Nov. 22, 1932. R. E. TALLEY 1,888,960

CONTINUOUS HARDENING, QUENCHING, AND DRAWING FURNACE

Filed May 13, 1932 6 Sheets-Sheet 5

Fig. 7.



INVENTOR

Randal E. Talley

by William D. Jaspert

attorney.

Nov. 22, 1932. R. E. TALLEY 1,888,960

CONTINUOUS HARDENING, QUENCHING, AND DRAWING FURNACE

Filed May 13, 1932 6 Sheets-Sheet 6

Fig. 8.

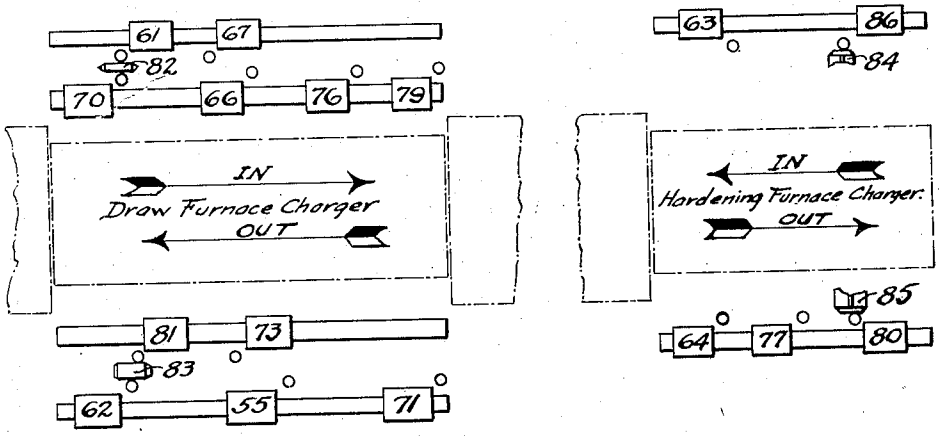


Fig. 9.

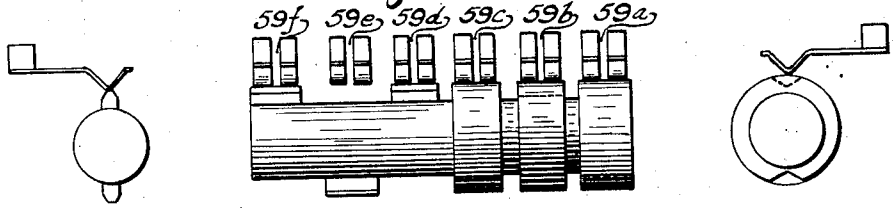
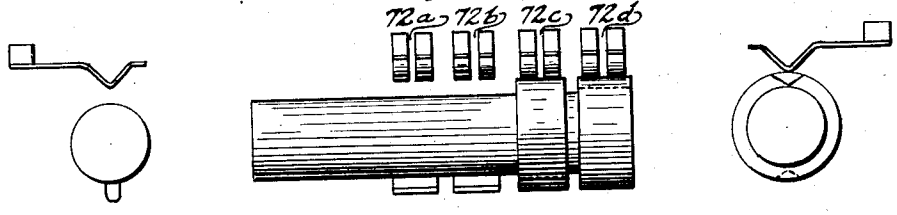


Fig. 10.



INVENTOR
Randal E. Talley
by William B. Jaspert.
Attorney.

Patented Nov. 22, 1932 1,888,960

UNITED STATES PATENT OFFICE

RANDAL E. TALLEY, OF IRWIN, PENNSYLVANIA, ASSIGNOR TO GEORGE J. HAGAN COMPANY, OF PITTSBURGH, PENNSYLVANIA, A CORPORATION OF PENNSYLVANIA

CONTINUOUS HARDENING, QUENCHING, AND DRAWING FURNACE

Application filed May 13, 1932. Serial No. 611,040.

This invention relates to continuous heating furnaces, more particularly to improvements in apparatus for heating, quenching and drawing metal articles such as automobile axles or the like, in a continuous process at a predetermined time cycle, whereby the articles are subject to uniform heat treatment.

It is among the objects of the invention to provide continuous heating furnaces of the above designated character wherein the articles to be treated are initially charged into a hardening furnace at a uniform rate, conveyed through the furnace at a predetermined time cycle, and after they are subjected to a uniform heat treatment, they are automatically withdrawn from the furnace, subjected to a definite quenching period, and finally conveyed through a draw furnace.

A further object of the invention is the provision of means for coordinating the movement of the charge through the hardening furnace with the movement of the door operating mechanism, to open and close the discharge opening of the hardening furnace in synchronism with the movement of the means for removing the charge from the hardening furnace.

A further object of the invention is the provision of a charge manipulator and indexer which shall be adapted to remove the work from the hardening furnace, submerge it in the quench for a predetermined time, and subsequently charge it into the draw furnace and convey the charge through the latter at a predetermined rate.

A further object of the invention is the provision of means whereby the charge manipulator and indexer cooperates in its movement with a quenching arm which lifts the charge from the supporting shoes, lowers it into the quench and subsequently replaces it on the shoes.

A still further object of the invention is the provision of a control system whereby the operations of the several operating parts of the hardening furnace, quench and raw furnace together with the pusher mechanism, charge manipulator and door operating mechanisms are properly controlled to render them cooperative in their movements.

In the accompanying drawings constituting a part hereof and in which like reference characters designate like parts:

Figure 1 is a vertical cross-sectional view taken longitudinally of a hardening furnace, quench mechanism and draw furnace embodying the principles of this invention;

Figure 2 a transverse sectional view thereof taken along the lines II—II;

Figure 3 a top plan view of the charge manipulator and indexer mechanism;

Figure 4 a vertical longitudinal sectional view of the hardening furnace and pusher mechanism partially broken away;

Figure 5 an enlarged detail view of the discharge end of the hardening furnace showing the work manipulator partially in section, the quench mechanism in side elevation, and the charging end of the draw furnace;

Figure 6 a wiring diagram of the control circuits controlling the hardening furnace charger drive, the door drive mechanism, the draw furnace charger drive, the quench drive intermediate relays, and time clock for initiating and controlling the movements of said drive mechanisms.

Figure 7 a schematic diagram of the control circuits;

Figure 8 a schematic diagram showing the location of numerous limit switches which open and close in response to the movements of the charging mechanism;

Figure 9 an enlarged view showing diagrammatically the rotary switch which is geared to the quenching cradle drive; and,

Figure 10 an enlarged view showing diagrammatically the rotary switch which is geared to the door drive.

With reference to Figure 1 of the drawings, the structure therein illustrated comprises a hardening furnace generally designated by the reference character 1, a quenching tank designated 2, and a draw furnace 3. The hardening furnace 1 consists of end walls 4 and 5, an insulating roof structure 6, a hearth 7, combustion chambers 8, doors 9 and 10 controlling the charge and discharge passages respectively, their operating mechanism generally designated at 11 and

12 with a motor driven link 13, drive motor 14 and a transmission 15.

The work is supported on shoes 16 Figure 5, which are provided with notches or corrugations 17 in which the work to be treated such as automobile axles are placed, and the work supporting shoes are charged into the hardening furnace 1 by means of a pusher mechanism generally designated at 18, Figure 1. The pusher mechanism is operated by a motor 19 through a drive 20 to manipulate a pusher ram 21 which is screw operated and adapted to travel back and forth to convey the shoes into the furnace and to push the contiguous shoes over the furnace hearth.

As shown in Figure 1 and more clearly in Figure 4, the hearth 7 of the hardening furnace is provided with skid rails 22 which terminate in a shoulder 23 to provide means for abutting unloading fingers 30 therewith in the manner to be hereinafter described.

A charge manipulator and indexer generally designated at 25 is mounted for reciprocating movement on a frame structure 26 directly over the quench tank 2. The charge manipulator and indexer is more clearly shown in Figures 2 and 3 of the drawings and constitutes a pair of channel frames 26 on which aprons 27 are mounted for sliding movement, the aprons being subjected to longitudinal movement on the frames 26 by a screw and nut mechanism actuated through the gear wheels 28 at the end of a screw shaft 29, Figure 3. The screw shafts are motor operated and subject the charge manipulator and indexer to reciprocating movement in timed relation with the operation of the pusher and door operating mechanism in a manner to be hereinafter stated.

The work carrying shoes when received by the charge manipulator are supported on the fingers 30 which are disposed between a plurality of serrated members 31 having corrugated faces 32 corresponding to the corrugations or spacings 17 of the shoe member 16 in Figure 5. The members 31 are mounted on a quenching arm 33 which is pivoted on the axle 34, all of which is more clearly shown in Figure 5 of the drawings. The members 31 are pivotally mounted at 35 on the quenching arm 33 and are provided with a lever 36 that is connected by a link 37 to a hinge bracket 38 provided at the side of the quenching tank 2.

The shaft 34 is provided with a crank lever 39 having a link connection 40 with a crank 41 of a reducer mechanism that is operatively connected to a drive motor 42.

The lever 39 is provided with counterweights 43 which are adjustable to counterbalance the weight of the work engaging members 31 and the lever arm 33 in their return movement to their work receivng and discharge position.

With reference to the charge manipulator and indexer, the work supports 30 disposed between the aprons 26 are connected by the frame structure with the aprons 26 and are rendered movable therewith in response to movement of the screw and nut mechanism actuated by the gear wheels 28.

The work carrying shoes as they are received from the hardening furnace when the supports 30 abut against shoulder 23 of rails 22 are moved in a longitudinal direction through the reciprocatory movement of the manipulator 25 and are ultimately conveyed to the charging end of the draw furnace 3 into which they are charged when they abut with the end 45 of the supports 30.

As the draw furnace 3 is operated at lower temperatures than the hardening furnace 1, the charging opening 46 of the furnace need not be controlled by a door and it is therefore continuously open. The work carrying shoes are pushed along the hearth 47 of the draw furnace until they reach the discharge opening 48, from which they are discharged, the position of the door 49 being adjusted to a height to permit the charge to pass.

The draw furnace is heated by means of the combustion chambers 50 directly below the hearth, although other methods of heating the draw furnace may be employed.

The operation of the drive motors of the pusher, the door operating motors, the charge manipulator and indexer, and the quenching arm are coordinated through a series of control elements, as shown and described in connection with Figures 6 to 10 of the drawings.

The control mechanism is periodically placed in motion by means of a time clock shown in Figures 6 and 7. This time clock is a motor driven timing instrument with means for momentarily completing an electrical circuit through its contact 51*a*, Figure 7, at definite predetermined intervals.

For the purpose of simplification, the wiring diagram Figure 7 shows the various control relays, switches and contactors in diagrammatic form, the component parts of the various controlling mechanisms being shown separately, so as to make it possible to trace through the large number of control circuits involved. The numerical number in each case relates to a complete element of control as shown in Figure 6, such as a relay or a switch, but in those cases where the controlling device is made up of a number of component parts, these component parts are marked with the numerical number of the parent device, together with a letter suffix. The clock relay, for example, is generally designated as Item 52 Figure 6. This relay is not shown as an assembly in the schematic diagram Figure 7; the component parts of this relay, however, do appear and are so placed on the diagram as to make their functions clear and readily traceable, the magnetic coil of the clock relay

being marked 52*a* and the clock relay contact points 52*b*. The remaining control elements are shown and designed in like manner.

There are four major elements which must be coordinated and made to move in ordered sequence by the control mechanism Figure 6. The charger head 21 must move forward and back; the hardening furnace doors 9 and 10 must move up and down; the quenching cradle 31 must move up and down; and the charge manipulator 25 must be moved to three positions, i. e., forward, back and intermediate.

The rest positions of the four working elements, i. e., the positions in which these elements remain stationary for a period after the completion of a cycle of operations, are as follows:

The hardening furnace charger head 21 is in the out position, i. e., away from the hardening furnace.

The hardening furnace doors 9 and 10 are in the down or closed position.

The quenching cradle 31 is in the up position.

The charge manipulator 25 is in the out position, i. e., away from the hardening furnace.

With the four working elements in the position of rest as enumerated above, the control relays and switches are in either the open or closed position, as shown in the wiring diagram Figure 6.

Rotary switch 59 is geared to the drive of quenching cradle 31 in such ratio that the control drum of switch 59 makes one revolution for each revolution of cradle impelling crank 41. When cradle 31 is in the up position as shown, the contacts of switch 59 are in the position as shown in Figure 6. When cradle 31 is in the down position as shown in dotted lines, the control drum of switch 59 is rotated 180 degrees from the position shown.

Rotary switch 72 is geared to the driving mechanism which opens and closes the doors 9 and 10 of the hardening furnace. When doors 9 and 10 are in the closed position as shown, the control drum of switch 72 is in the position shown. When doors 9 and 10 are open, the control drum of switch 72 is rotated 180 degrees from the position shown.

Switches 61, 63, 66, 67, 70, 76, 79 and 86 are limit switches of construction well known in the art. The foregoing switches are all provided with normally open contacts. Limit switches 55, 62, 64, 71, 73, 77, 80 and 81 are similar in construction, except that this lot of switches are provided with normally closed contacts.

Switch P1 is a conventional on and off push button through which power is supplied for the control circuits Figure 6.

Switch P2, P3, P4, P5, P6, P7, P8 and P9 are double contact push buttons of conventional design with the upper set of contact points normally closed as shown in the diagram Figure 6. By depressing the button to an intermediate position and then rotating the button 90 degrees, the contacting member is then retained in this intermediate position and both the upper and lower contacts are open. With the switches in this position they then become what is known as momentary contact or inching buttons, and by depressing the contact member to close the lower set of contacts the control circuit for each of the material handling members may be individually energized, thus providing complete manual control when desired.

Switch P10 is a push button identical in construction to the switches previously described. With this switch in the normally closed position as shown in Figure 6, the timing of the interval of operation is under the automatic control of the time clock, as will hereinafter be described. With switch P10 depressed and locked in the intermediate position the time clock is eliminated from the circuit, further depressing the push button to make momentary contact on the lower set of contacts providing manual control.

Contacts 92, 93, 94 and 95 are overload devices of conventional design arranged to open automatically in case of accidental overload.

Parts 88, 89, 90 and 91 are solenoid brakes of conventional design employed with each of the driving motors as shown in Figure 6. The function of these brakes is to quickly and accurately stop the motion of the different material handling elements so as to obtain accurate indexing in response to the automatic control elements.

Switch operating lugs 82 and 83 are attached to and move with manipulator 25. Switch operating lugs 84 and 85 are attached to and move with charger head 21.

At the expiration of the period of rest, clock contact 51*b* closes momentarily and energizes clock relay coil 52*a*, thus causing clock relay contact 52*b* to close.

The closing of contact 52*b* causes current to pass through relay coil 53*a* and thus closes contacts 53*b*, 53*c*, 53*d*, 53*e* and 53*f* respectively.

Contact 53*b* is an interlocking contact which serves to keep relay coil 53*a* energized after clock contact 51*b* has opened. As previously noted, clock contact 51*b* closes only momentarily and when clock contact 51*b* opens, clock relay contact 52*b* also opens and it is therefore necessary to provide interlocking contact 53*a* to maintain current in coil 53*a* until such time as the functions dependent upon this circuit have been completed.

The closing of relay contact 53*d* energizes the starter coil 54*a* and puts in motion manipulator motor 86. The manipulator then moves toward the hardening furnace until it reaches the intermediate position, where

it stops due to the opening of limit switch 55 by means of switch operating lug 83.

As the manipulator 25 moves away from its "out" position, lug 83 passes out of engagement with limit switches 62 and 81 and allows them to close. Projecting lug 82 at the same time passes out of engagement with switches 61 and 70 and allows them to open.

The opening of switch 61 interrupts the current in coil 56*a*, thus causing contact 56*b* to open.

With the manipulator 25 in its intermediate position, limit switches 66 and 67 are held closed by lugs 82. The closing of these two switches energizes relay coil 68*a* and thereby closes relay contacts 68*b*, 68*c*, 68*d* and 68*e*.

The closing of contact 68*c* completes the circuit through motor starter coil 69*a*, puts in motion motor 42 and lowers the quenching cradle 31 to the "down" position shown in dotted lines Figure 5. With the manipulator in its intermediate position, carrier shoes 17 are directly beneath the previously quenched charge of material resting transversely on quenching cradle 31; therefore, as quenching cradle 31 moves downward, the charge is transferred to carrier shoes 17, cradle 31 continuing, now empty, to its point of rest in the "down" position, where it is stopped by the opening of contact 59*c*.

The closing of relay contact 68*d* energizes motor starter coil 75*a*, thereby setting in motion door motor 14 to raise hardening furnace doors 9 and 10. When the doors reach the open position, rotary switch 72 opens contact 72*d* and closes contacts 72*a*, 72*b* and 72*c*. The opening of contact 72*d* interrupts the current in motor starter coil 75*a* and stops the doors in their open position.

The closing of contact 72*a* energizes motor starter coil 54*a* and starts manipulator motor 86, to move manipulator 25 from the intermediate position toward the "in" position. During the forward travel of manipulator 25, projecting lug 82 closes switch 76, which energizes motor starter coil 78*a* and sets in motion motor 19 to move charger head 21 toward the hardening surface.

The manipulator 25 continues to move toward the hardening furnace and is brought to rest in the "in" position by projecting lug 83, which engages and opens limit switch 71. Limit switch 79 is simultaneously closed by means of projecting lug 82.

Charger head 21 in the meantime continues its motion toward the hardening furnace until it is brought to rest in the "in" position by projecting lug 85 engaging and opening contact 64, which interrupts the circuit through relay coil 57*a*, thus opening relay contact 57*c* and de-energizing motor starter coil 78*a*.

Limit switch 77 is employed for safety purposes only. During the forward travel of charger head 21, switch 77 is opened by projecting lug 85 as it passes, but if at that time manipulator 25 has reached the "in" position and thereby closed limit switch 79, the circuit through switch 77 is bridged and charger head will therefore continue to move toward its "in" position without interruption. If, however, the manipulator has not reached its "in" position by the time projecting lug 85 reaches switch 77, the opening of switch 77 will arrest the forward motion of charger head 21 at this point until the manipulator reaches the "in" position and switch 79 is closed, whereupon the charger head 21 will continue its inward travel and come to rest in the "in" position as previously described. The foregoing safety provision is necessary to insure that the receiving fingers 30 of manipulator 25 are in position, abutting the skid rails of the hardeneng furnace, as the fresh charge is pushed off the skid rails of the hardening furnace onto the manipulator fingers by the forward motion of the charger head 21.

When charger head 21 has reached the "in" position, projecting lug 84 closes switch 63. This establishes a circuit through relay coil 58*a* and closes relay contact 58*b*, which in turn establishes a circuit through relay coil 60*a* and closes contacts 60*b*, 60*c*, 60*d*, 60*e* and 60*f*.

The closing of contacts 60*f* establishes a circuit through motor starter coil 78*b*, which starts charger motor 19 in the reverse direction and carries charger head 21 away from the hardening furnace until it comes to rest in the "out" position by projecting lug 85 engaging and opening switch 80.

The closing of contact 60*d* establishes a circuit through motor starter coil 54*b*, which starts manipulator motor 87 in reverse to move manipulator 25 away from the hardening furnace. The manipulator continues to move out until projecting lug 83 engages and opens switch 73, which stops the manipulator 25 in its intermediate position. In this position, projecting lug 83 also opens switches 55 and projecting lug 82 closes switches 66 and 67. The closing of switches 66 and 67 energizes relay coil 68*a*, which in turn closes relay contacts 68*b*, 68*c*, 68*d* and 69*e*.

The closing of contact 68*e* completes the circuit through motor starter coil 75*a*, which starts door motor 14 and closes doors 9 and 10, the doors being stopped in their closed position by the opening of rotary switch contact 72*c*.

The closing of relay contact 68*b* energizes the motor starter coil 69*a*, which sets in motion cradle motor 42 and raises cradle 31 to the "up" position, where it is stopped by the opening of contact 59*b*. In this position of rotary switch 59, contacts 59*a*, 59*c*, 59*d* and 59*f* are closed; 59*b* and 59*e* are open. The opening of contact 59*b* stops the cradle 31 in the up position, as noted. During the

upward travel of cradle 31 the heated charge is lifted from the carrier shoes 17.

The closing of contact 59*f* energizes motor starter coil 54*b* and sets in motion manipulator motor 87 and moves manipulator 25 to the out position, where it is stopped by projecting lugs 83 engaging and opening limit switch 81. In this position of the manipulator, limit switch 62 is also open and limit switches 61 and 70 are closed. In this position of the manipulator the carrier shoes at rest on fingers 30 are removed from beneath the charge.

The closing of limit switch 70 energizes motor starter coil 69*a* and sets in motion cradle motor 42, which lowers cradle 31 with its charge to the down position, where it is stopped by the opening of rotary switch contact 59*c*. In this position of rotary switch 59, contacts 59*a*, 59*c*, 59*d* and 59*f* are open; contacts 59*b* and 59*e* are closed.

The closing of limit switch 61 energizes relay coil 56*a*. Relay 56 is a delayed time relay of construction well known to the trade and the timing of this relay is set to give the proper time interval for the charge to remain in the quench. After this time has elapsed, the relay contact 56*b* is closed, which energizes motor starter coil 69*a* and sets in motion cradle motor 42, which raises cradle 31 with its charge to the "up" position, where it is stopped by the opening of rotary switch contact 59*b*. This completes one cycle of operation. All contacts are now restored to the position as shown in Figure 6 and the mechanism remains at rest until the expiration of the charging interval, when clock contact 51*b* again closes and repeats the cycle of operation.

The work supporting shoes 16 are manipulated by member 25 as follows:

When the shoes are pushed through furnace 1 on the skid rails 22 by pusher 21 the shoes advance to the discharge end where they are received by the manipulator fingers 30 as they abut against shoulders 23. Manipulator 25 then moves to the intermediate position and in doing so the shoes on fingers 30 engage the shoes previously delivered to the draw furnace. Since the end shoes of the row are in the path of movement of fingers 30, they act as an abutment for the shoes on the manipulator causing them to be moved forward to index the shoes last received from the hardening furnace in proper position over the quenching cradle 31. This function of the manipulator may be termed the indexing of the shoes to bring them in register with the quenching member 31.

When the shoes received from the hardening furnace are in register with the quenching cradle 31 the latter is raised to lift the work out of the grooves 17 of the shoes and the empty shoes are moved away. The cradle 31 then lowers the work into quench tank 2 in which it is held a predetermined time and then returned to the position where the articles will register with the grooves 17 of shoes 16 when the latter are returned by the manipulator. In this manner the work is quenched without cooling the shoes thereby reducing the heat consumption for reheating the articles to the drawing temperature after quenching.

The indexing of the work supporting shoes must be carried on in the manner stated to register the articles with the quenching cradle as otherwise the shoes would not be uniformly delivered to the proper position above the quench. Where long rows of work supporting shoes are passed through a hardening furnace, the length of the row varies due to thermal expansion and growth of the alloy of which they are composed and by the indexing method described above such variations in lengths are compensated for.

By means of the control described in connection with Figures 6 to 10 of the drawings the movements of the pusher, manipulator and quench arm are coordinated and timed to subject the work to definite heat and quenching cycles in a continuous process.

I claim as my invention:

1. Apparatus for heating, quenching, and reheating articles to be treated, comprising in combination a pair of furnace chambers in end to end relation having a quench tank disposed therebetween, a pusher mechanism for conveying articles to be heated through one of said furnaces, a charge manipulator and index mechanism for receiving the heated article from said furnace, means associated with the quenching tank for lifting the articles from said charge manipulator and submerging the same into the quench, said means being operative to return the quenched articles to said charge manipulator, and means for conveying the charge from the manipulator to the draw furnace and for pushing the same therethrough.

2. In a continuous treating apparatus for hardening, quenching, and drawing articles with grooved supporting shoes for holding the charges in spaced relation, pusher mechanism for conveying said work supporting shoes through a hardening furnace, a manipulator for receiving said shoes and for moving them in position over a quenching tank, means for engaging the charges on said shoes and lifting them therefrom, means for operating the manipulator to move it out of alinement with said lifting means, means for causing the lifting means to dip the charges into the tank and return them to their upper position in a predetermined time cycle, means for returning the manipulator to bring the the shoes with their grooves in register with the charges, means for operating the dipping arm to lower the charges in the grooves of the shoes, and means for moving the manip-

ulator to displace the shoes in the direction of a drawing furnace.

3. Apparatus for hardening, quenching and drawing charges by continuous process comprising a hardening furnace, a quench tank, and a draw furnace, arranged in cooperative alinement, pusher mechanism for the hardening furnace, work supporting shoes adapted to be pushed through the hardening furnace by the pusher mechanism a distance corresponding to substantially the length of the shoes, a manipulator for receiving each shoe as it is discharged from the hardening furnace by the pusher mechanism and for conveying the same to a position above the quench tank, a dipping arm adapted to engage the charges on said shoes to clear them from the shoes and dip them into the quench and return them to their original position, means for operating the manipulator to move it out of alinement with the dipping arm after the charges have been lifted from the shoes and to return the shoe to the alined position to receive the charge after it has been returned from the quench by the dipping arm, said manipulator being operative to advance the shoes into and through the draw furnace after they have received the charges from the quenching tank.

4. Apparatus for hardening, quenching, and drawing articles to be treated by continuous process comprising a hardening furnace having a plurality of skid rails, a pusher mechanism at the charging end of the furnace in cooperative alinement with said rails, work supporting shoes for receiving charges adapted to be charged into the furnace and conveyed on the rails to the discharge end thereof, a manipulator operative for receiving the shoes from the discharge end of the furnace and moving them in position above the quench tank, a dipping arm for lifting the charges from the shoes, submerging them in the quench and returning them to their lifted position, means for moving the manipulator in position to bring the empty shoes in alinement with the quenched charge to receive the same upon lowering of the dipping arm, and means for displacing the shoes from the manipulator into the draw furnace to convey the shoes through the draw furnace in synchronism with the movement of the shoes through the hardening furnace.

5. Apparatus for hardening, quenching, and drawing articles by continuous process comprising a hardening furnace, a quench tank, a draw furnace, and a charge manipulator and index mechanism in alinement with the hearth of said furnaces, pusher mechanism for conveying charges through the hardening furnace onto the charge manipulator and index mechanism, means for lifting the charges from the manipulator, subjecting them to the quenching medium and returning them to the manipulator, and means for timing the movement of the manipulator with the movement of the quenching means and for receiving the quench charges and conveying them to the draw furnace.

6. Apparatus for hardening, quenching, and drawing charges by continuous process comprising a draw furnace, a charge manipulator and index mechanism, and a hardening furnace, the hearths of said furnaces being in substantial alinement with the charge manipulator and index mechanism, and a quenching mechanism for lifting the charges from the manipulator and subjecting them to dipping action in the quench and returning them to the manipulator, said manipulator subsequently transferring the charges to the hearth of the draw furnace and pushing successive charges into said furnace whereby to convey them along the hearth of the furnace to the discharge end thereof.

7. Apparatus for hardening, quenching, and drawing charges comprising a hardening furnace and a draw furnace in end to end relation having a quench tank disposed therebetween, a charge manipulator for receiving the charges from the hardening furnace, conveying the same to the quench tank and subsequently receiving them to convey them to the draw furnace, means for removing the charges from the manipulator to subject them to a quench and return them to the manipulator, pusher mechanism for conveying the charges through the hardening furnace, door operating mechanism controlling the charge and discharge openings of the hardening furnace, and control means for said charge conveying and manipulating mechanism including a timing mechanism operative pursuant to the initiation of action thereof to charge and convey the articles through the hardening furnace, receive the same from the hardening furnace and deliver them above the quench, remove them from the receiving means and subject them to the quenching medium for a definite period and return them to the receiving means, and subsequently convey them to and through the drawing furnace.

8. Apparatus for conveying charges through a hardening and a draw furnace and for subjecting them to a dipping action in a quench, comprising a pusher mechanism for pushing the charges through the hardening furnace, a manipulator for removing the charges from the hardening furnace to a position above the quench, a dipping mechanism for receiving the charges from the manipulator, dipping them in the quench and returning them to the original position where they are again received by the manipulator, said manipulator subsequently conveying the charges through the draw furnace, and electrically operated means including a

control for coordinating the movements of the pusher mechanism, the charge manipulator, and the dipping mechanism, whereby the charges are subjected to a definite heating and quenching cycle.

9. Apparatus for hardening, quenching, and drawing charges as set forth in claim 8 characterized by control mechanism including a plurality of electrical switches for energizing the electrical operating means, the said switches being in the path of movement of the hardening furnace charger, and the charge manipulator, to render the electrical operating means effective at predetermined intervals.

10. Apparatus for receiving, quenching, and conveying furnace charges comprising a charge manipulator adapted for reciprocating movement in a horizontal plane and a dipping arm cooperating with said manipulator to lift the charge therefrom, lower the same into a quench, and return it to position where it is again placed on the manipulator and conveyed to a receiving station.

11. Apparatus for quenching furnace charges comprising in combination a charge manipulator adapted for reciprocating movement in a horizontal plane, a dipping arm cooperating therewith, means for moving the manipulator to register the charges with the dipping arm, means for lifting the charges from the manipulator, subjecting them to a quench, and returning them to the manipulator, and means for conveying said charges from the manipulator to a receiving station.

12. Apparatus for automatically quenching furnace charges comprising in combination with a tank containing a quenching medium, a charge manipulator mounted for reciprocating movement above said tank, a dipping arm cooperating with said manipulator, means rendering said manipulator operative for receiving a charge and delivering the same to a position in register with said dipping arm, means for actuating the dipping arm to lift the charges from the manipulator, submerge them in the quench, and return them to said manipulator, and means for actuating the manipulator to deliver the charge to a receiving station.

13. Apparatus for conveying charges through a hardening and a draw furnace and for subjecting them to a dipping action in a quench, comprising a pusher mechanism for pushing the charges through the hardening furnace, a manipulator for receiving said charges from said pusher mechanism and for delivering said charges to a draw furnace, said manipulator being adapted to index said charges to position them at a predetermined point over a quench, a dipping arm for lifting the charges from the charge manipulator, subjecting the same to a dipping action into the quench and returning them to the manipulator, and means for coordinating the movements of the pusher mechanism, the charge manipulator, and the dipping arm to convey the charges through the furnaces and subject them to a dipping action whereby to subject them to uniform heat treatment.

14. Apparatus for receiving and conveying furnace charges comprising a manipulator mounted for movement in a horizontal plane, screw mechanism subjecting said manipulator to reciprocating movement, a motor for operating said screw mechanism, and control means for said motor whereby the reciprocating movement of said manipulator is arrested at predetermined timed intervals.

15. Apparatus for receiving, quenching, and delivering furnace charges comprising a container for a quenching fluid, a charge manipulator mounted for movement in a horizontal plane above said container, a screw mechanism for actuating said manipulator to subject it to reciprocating movement, a dipping arm cooperating with the manipulator to receive the charges therefrom, subject them to a dipping action in the quenching fluid and return them to the manipulator, motor operated means for said screw mechanism and motor driven means for said dipping arm, and control means for said motors to render them operative to arrest the movement of the manipulator when the charge is in register with the dipping arm, to actuate the dipping arm to quench the charge and return it to the manipulator during the period of rest of the latter, and to again actuate the manipulator to convey the charge to a receiving station while the dipping arm is at rest.

16. Apparatus for delivering charges through a furnace, subjecting them to quenching, and conveying them to a receiving station comprising in combination a pusher mechanism, a charge manipulator cooperating with the pusher mechanism to receive the charges therefrom, a dipping arm cooperating with the manipulator to lift the charges from the manipulator, subject them to a dipping action in a quench and return them to said manipulator, motor operated means for actuating the pusher mechanism, the manipulator, and the dipping mechanism, and control means for rendering said motor operated means operative upon initiation of action thereof to carry out the cycle of delivering charges to the manipulator, removing same, and subjecting them to a quenching action and returning the same to the manipulator to be conveyed to a receiving station in the order stated.

In testimony whereof I have hereunto set my hand.

RANDAL E. TALLEY.