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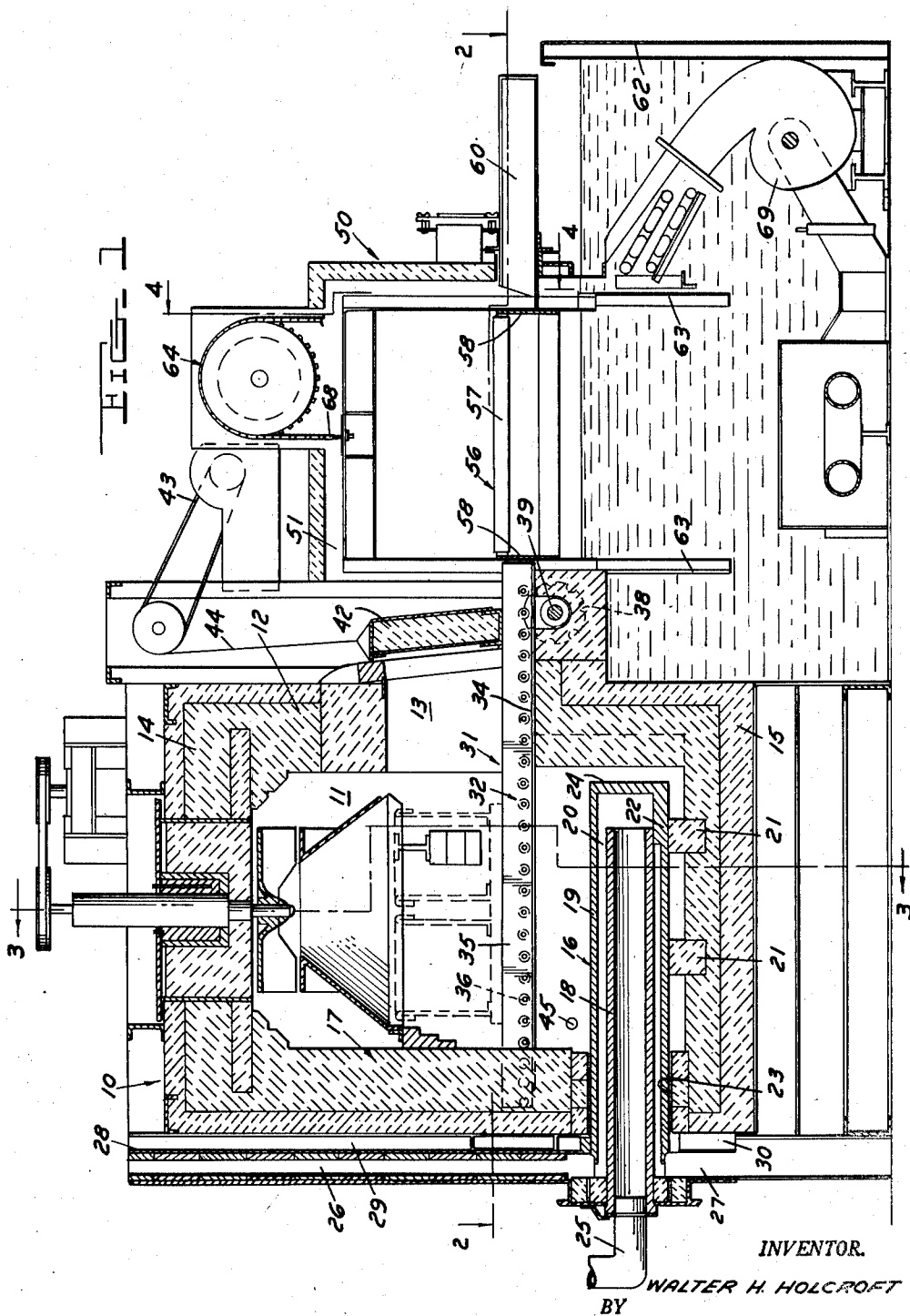
W. H. HOLCROFT

2,669,445

HEAT-TREATING APPARATUS

Filed Feb. 13, 1950

3 Sheets-Sheet 1



INVENTOR.
WALTER H. HOLCROFT
BY
William K. Kuhn & Billings
ATTORNEYS

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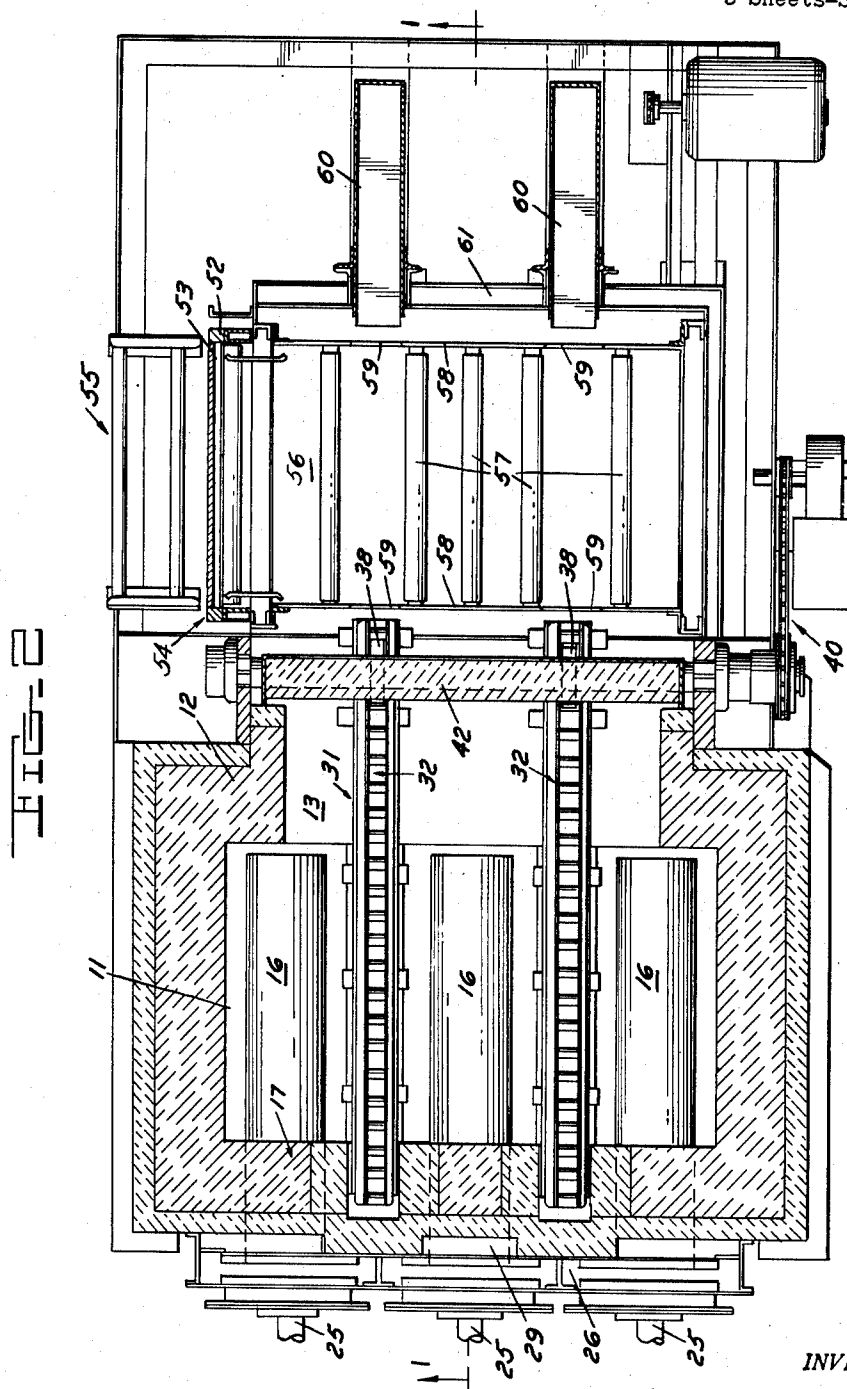
W. H. HOLCROFT

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HEAT-TREATING APPARATUS

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3 Sheets-Sheet 2



INVENTOR.

WALTER H. HOLCROFT
BY

Wentmore, Hullin & Bell
ATTORNEYS

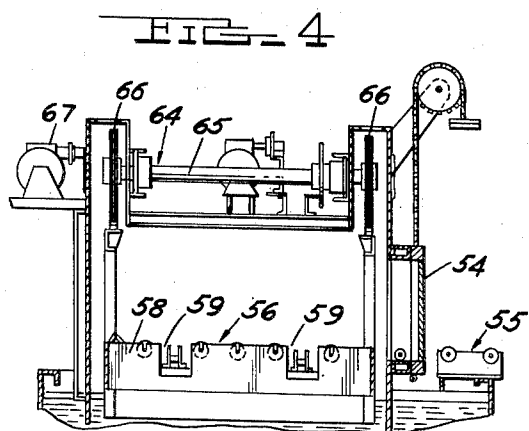
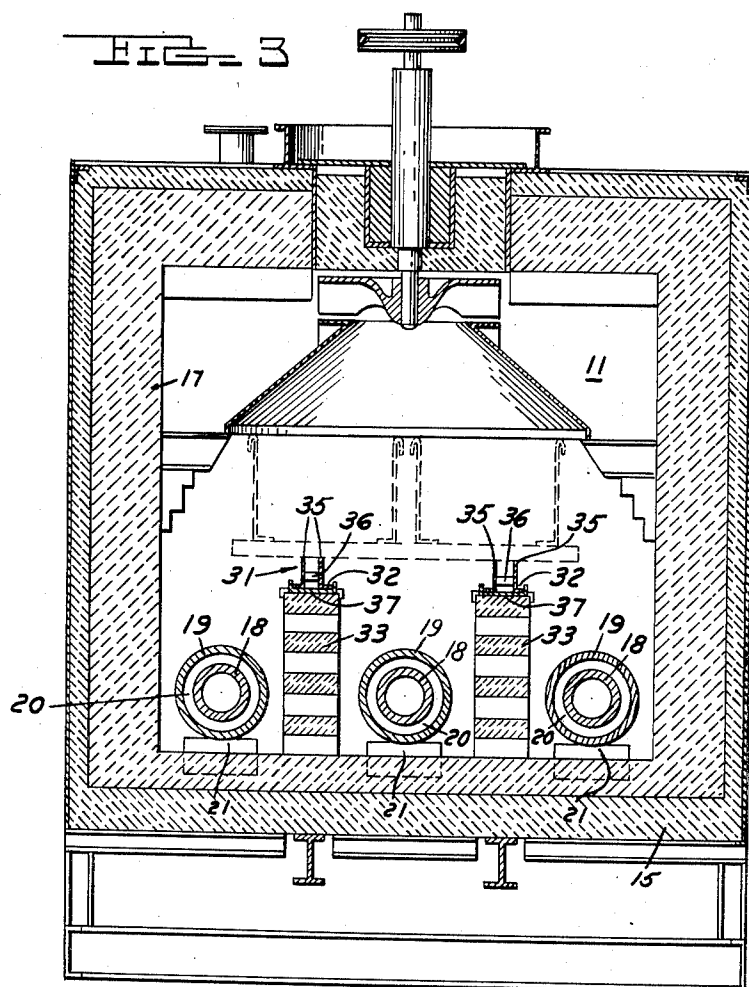
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W. H. HOLCROFT
HEAT-TREATING APPARATUS

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3 Sheets-Sheet 3



INVENTOR.

WALTER. H. HOLCROFT
BY

Whitmore, Nutter & Belknap
ATTORNEYS

UNITED STATES PATENT OFFICE

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HEAT-TREATING APPARATUS

Walter H. Holcroft, Detroit, Mich., assignor to
Holcroft & Company, Detroit, Mich., a corpo-
ration of Michigan

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This invention relates to heat treating apparatus of the type having an atmosphere controlled furnace and having quenching means associated with the furnace.

It is an object of this invention to provide relatively simple heat treating apparatus capable of being readily operated with a minimum amount of attention on the part of personnel, and also being of a design which enables installation in a relatively small space at a minimum cost. In accordance with this invention all of the various operations may be automatically carried out in their proper sequence, and the furnace, as well as the associated quenching tank, may be supported at floor level, rendering it unnecessary to provide pits for subfloor installations.

It is another object of this invention to provide improved relatively simple means for introducing the articles to be heated into and for removing the same from the furnace. Briefly the furnace has a single opening in one wall, and the hearth of the furnace is in the form of a work supporting carriage movable into and out of the furnace through said opening.

Still another object of this invention is to provide a work supporting platform operating in conjunction with the carriage to deposit the work or articles to be treated on the carriage in the outermost position of the latter and also operable to lift the articles off of the carriage after the articles are withdrawn from the furnace by the carriage.

It is a further object of this invention to provide a work supporting platform of the above type which serves as an elevator to lower the articles into and remove the same from a quenching tank supported beneath the platform.

It is a still further feature of this invention to provide improved burners arranged and operated to assure maintaining a uniform temperature within the heating chamber of the furnace.

In addition to the above this invention provides an arrangement wherein the exhaust from the burners induces a flow of air upwardly in heat conducting relation to an outer wall of the furnace to cool the latter wall.

The foregoing as well as other objects will be made more apparent as this description proceeds, especially when considered in connection with the accompanying drawings, wherein:

Figure 1 is a sectional view taken on the line 1—1 of Figure 2;

Figure 2 is a sectional view taken substantially on the plane indicated by the line 2—2 of Figure 1;

Figure 3 is a sectional view taken on the line 3—3 of Figure 1; and

Figure 4 is a sectional view taken on the line 4—4 of Figure 1.

The heat treating apparatus selected herein for the purpose of illustrating the present invention is particularly adapted for use in heat treating articles while supported by suitable trays not shown herein. Upon reference to Figures 1 to 3 inclusive of the drawings, it will be noted that the numeral 10 designates a furnace having walls formed of a high heat resistant refractory material and cooperating to form a heating chamber 11 within the furnace. One wall 12 of the furnace is formed with an opening 13 there-through intermediate the top and bottom furnace walls 14 and 15 respectively. The opening 13 is of sufficient size to enable trays supporting the work to be heat treated to be introduced into and removed from the heating chamber 11.

The interior of the chamber 11 is heated to the desired temperature by a plurality of radiant type burners 16 supported within the chamber 11 below the access opening 13. In Figure 2 of the drawings, three burners 16 are shown, although it will be understood that the number of burners may be varied to suit different requirements. As shown in the specific embodiment of the invention selected herein for the purpose of illustration, the burners are spaced equal distances from each other lengthwise of the heating chamber 11, and respectively project through openings formed in the side wall 17 of the furnace.

The burners 16 are identical in construction, and a description of one will suffice for all. As shown particularly in Figure 1 of the drawings, the burner comprises an inner tube 18 formed of a high heat resistant material and an outer tube 19 also formed of a heat resistant material. The internal diameter of the outer tube 19 is substantially greater than the external diameter of the inner tube 18, and the two tubes are supported in concentric relationship to provide an annular passage 20 therebetween.

The outer tube is supported on the bottom wall 15 of the furnace by laterally spaced refractory blocks 21, and the inner tube 18 is supported at its inner end by a spacer 22 located at the inner end of the outer tube 19. The outer end of the tube 19 projects through an opening 23 in the wall 17 of the furnace, and the inner end extends to a position immediately adjacent the opposite wall 12 of the furnace. It will be noted from Figure 1 of the drawings that the outer end of the tube 19 is open to the atmosphere, and

the inner end of this tube is closed by a wall 24.

The inner end of the tube 18 is open, and terminates short of the wall 24 to provide communication between the annular passage 20 and the interior of the tube 18. The outer end of the tube 18 projects outwardly beyond the corresponding end of the tube 19, and communicates with a source 25 of fuel supply. In the present instance the fuel supplied to the inner tube 18 is in the form of a combustible mixture of gases which are burned within the inner tube 18. The products of combustion issuing from the inner end of the tube 18 are caused to flow outwardly through the annular passage 20, and are discharged through the open outer end of the tube 19. Inasmuch as the tubes extend practically from one wall of the heating chamber to the opposite wall, it follows that the interior of the chamber 11 is uniformly heated from wall to wall.

The exhaust gases issuing from the outer end of the tube 19 are discharged into a stack 26 having a width approximating the length of the wall 17 and spaced laterally outwardly from the wall 17. The upper end of the stack communicates with the atmosphere beyond the top of the furnace, and the lower end 27 of the stack projects for some distance below the burners. The inner wall 28 of the stack cooperates with the wall 17 of the furnace to form a vertical passage 29 having the lower end 30 communicating with the atmosphere at a point spaced below the burners. It will be noted that the outer end of the tube 19 projects through the air passage 29 into the stack 26 so that the exhaust gases are discharged directly into the stack.

The upper end of the air passage 29 is open to the atmosphere immediately adjacent the corresponding end of the stack 26, so that exhaust gases flowing upwardly through the stack induce the flow of air upwardly through the passage 29. Air flowing upwardly through the passage 29 absorbs heat from the adjacent wall of the furnace, and tends to maintain this wall relatively cool.

The work to be heat treated is introduced into and removed from the heating chamber 11 by a carriage 31 comprising laterally spaced racks 32. As shown in Figures 1 and 2 of the drawings the racks 32 extend transversely of the heating chamber 11 above the burners 16, and project out of the furnace 10 through the opening 13.

Referring now to Figure 3 of the drawings, it will be noted that the racks 32 are respectively supported within the heating chamber on laterally spaced columns 33, and also on the bottom side 34 of the opening 13 in the manner shown in Figure 1 of the drawings. Each rack comprises laterally spaced rails 35 connected together by pins 36 extending between the rails and spaced from each other in the direction of length of the rails. The bottom edges of the rails are bent laterally outwardly to provide flanges, and the flanges slidably engage plates 37 respectively secured to the upper ends of the columns 33.

The above arrangement is such as to permit sliding movement of the racks into and out of the heating chamber through the opening 13. In the present instance the racks are moved as a unit by a pair of toothed wheels 38 located at the outer side of the furnace and secured to a drive shaft 39 in positions to respectively engage the racks. The drive shaft 39 is suitably journaled in bearings supported by the side wall 12 of the furnace, and is rotated in opposite direc-

tions by suitable driving mechanism 40 shown in Figure 2 of the drawings.

During the heating operation it is usually desired to maintain a nonoxidizing atmosphere within the heating chamber 11, and accordingly, the opening 13 is normally closed by a door 42 suitably supported at the outer side of the wall 12 and adapted to rest on the top surfaces of the racks 32 when in its closed position. The door 42 is power operated, and for this purpose, the top of the door is connected to driving mechanism 43 by a flexible member 44. Also a non-oxidizing gas is introduced into the heating chamber 11 through a conduit 45 at such a rate that the interior of the chamber is flooded with the desired gas at all times, and any tendency for air to escape into the chamber around the door is prevented.

The escape of air into the heating chamber 11 when the door 42 is open is prevented by providing a vestibule 50. The vestibule 50 is suitably supported at the outer side of the wall 12 of the furnace directly opposite the opening 13, and provision is made for flushing the vestibule with furnace atmosphere or some other suitable inert gas in order to maintain a nonoxidizing atmosphere therein. The inner side of the vestibule 50 is provided with an opening 51 in registration with the opening 13, and one end 52 of the vestibule has an opening 53, as shown in Figure 2 of the drawings. The opening 53 enables the articles to be heat treated to be introduced into the vestibule, and is normally closed by a counterweighted door 54 shown in Figure 4. It will also be noted from Figures 2 and 4 of the drawings that a table 55 is suitably supported at the outer side of the door 54 in a position to support the article holding trays prior to introducing the same into the vestibule 50.

Located within the vestibule 50 directly opposite the opening 13 is a platform 56. The platform 56 extends transversely of the racks 32 and comprises a plurality of rolls 57. As shown in Figure 2, the rolls 57 extend in the direction of length of the racks 32 and are spaced from each other longitudinally of the platform. The opposite ends of the rolls 57 are rotatably supported on side rails 58 of the platform, and the rails 58 are formed with slots 59. The slots 59 open through the top edges of the rails and are aligned with the racks 32.

The rolls 57 on the platform provide a supporting surface for the articles to be heat treated, and are normally positioned by the platform with the work supporting surfaces elevated with respect to the work supporting surfaces of the racks 32. As shown in Figure 2 of the drawings, the slots 59 are located between adjacent rollers 57 and provide clearance spaces for receiving the racks 32 when the latter are moved out of the heating chamber 11. In this connection it is pointed out that the outer ends of the racks are supported in the outermost position of the racks by channels 60 supported by suitable framework 61 at the outer side of the platform 56.

The platform 56 also serves as an elevator to lower the work into and raise the same from a quenching tank 62. As shown in Figure 1 of the drawings, the quenching tank 62 is supported at floor level directly below the platform 56, and vertical guides 63 are provided for guiding the platform into and out of the quenching tank. In the present instance the platform is operated by power means 64 shown in Figure 4 as comprising a drive shaft 65 and a pair of sprockets

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66. The drive shaft is journaled on suitable frame structure at the top of the vestibule 50, and is suitably connected to reversible drive mechanism 67. The sprockets are respectively supported at opposite ends of the platform, and are connected to the latter ends by suitable chains 68. The above construction is such that rotation of the sprockets 66 in one direction lowers the platform into the quenching tank 62 and rotation of the sprockets 66 in the opposite direction raises the platform out of the tank 62.

The tank 62 is adapted to contain the desired quenching liquid, and in accordance with conventional practice, the liquid within the tank is circulated by a high volume pump designated generally by the reference character 69. This particular construction is of orthodox design, and is therefore not described in detail herein.

Operation

Assuming that it is desired to introduce a tray containing articles to be heat treated into the furnace 10, the operator merely manually opens the door 54 to the vestibule 50 and moves the tray onto the platform 56. This operation is greatly facilitated by virtue of the rollers 55 and 57. The door 54 is then closed and a switch (not shown) in a suitable electric control system is closed to start a timer for the desired preset cycle. This cycle is sufficient to flush the vestibule of substantially all oxygen, carbon dioxide and water vapor by displacement or reaction with the atmosphere gas entering the vestibule from the furnace chamber 11. At the conclusion of this time cycle the power means 43 is operated and the door 42 is raised. The driving means 40 is then placed in operation to move the racks 32 out of the heating chamber 11 through the opening 13 in the furnace.

As the racks 32 are moved outwardly, they pass through the clearance spaces 59 beneath the tray or work supporting surface of the platform, and the latter is lowered by the power means 64 to deposit the articles or tray on the racks. The racks 32 together with the articles to be heated are then moved into the heating chamber 11, and the door 42 is closed. The heating cycle is then initiated, and the articles supported by the tray are heated to their proper temperature.

At the end of the heating cycle the door 42 is again opened by the driving mechanism 43, and the driving means 40 again moves the racks 32 to their outermost positions. It will be understood that the platform 56 is positioned below the elevation of the racks when the latter are moved outwardly to transfer the heated articles from the furnace into the vestibule 50. The platform 56 is then moved upwardly by the driving means 64 and the heated articles are transferred from the racks 32 to the platform 56. After this is accomplished the racks 32 are returned to their operative positions within the furnace chamber 11, and the door 42 is closed.

After the door 42 is closed, the elevator 56 is moved downwardly by the driving means 64 to lower the tray containing the heated articles into the tank 62. The pump 69 in the tank circulates the quenching liquid around the articles in the usual manner, and upon completion of the quenching cycle, the platform 56 is again raised to its uppermost position shown in Figure 1 of the drawings. The operator then opens the door 54 and removes the heat treated articles from the vestibule 50.

All of the above operations are preferably

carried out in sequence by suitable electrically controlled mechanism including the proper timers. Such control panels are commonly used in this art, and form no part of the present invention.

In the above operation it is to be noted that from the time of completion of heating the work on one tray in the heating chamber 11 until another tray is introduced into the heating chamber, there is an elapsed time consisting of three basic phases which are:

(1) Time required by quenching operation (controlled by a time clock in the electrical control system);

(2) Time required to pull out a tray from the vestibule and introduce another tray into the vestibule; and

(3) Time required for flushing the vestibule (also controlled by a time clock in the electrical control system).

During the time no work is being heated in the heating chamber, the operating temperature is preferably automatically increased in order to store heat in the furnace lining. In other words during the elapsed time of quenching, loading, reloading and flushing, heat is stored in the furnace chamber walls. This stored heat is subsequently abstracted from the furnace walls, and serves to decrease the time required to heat the work introduced into the heating chamber on the next cycle of operation.

It will be noted from the foregoing that the heat treating apparatus as a whole is very simple and compact. It will further be noted that the design of the heat treating apparatus is such as to enable supporting the quenching tank at floor level, which greatly simplifies installation of the apparatus. Aside from the above, it will be seen that the heating means provided in the furnace is highly efficient, and assures maintaining a uniform temperature throughout the chamber 11.

What I claim as my invention is:

1. Work handling mechanism comprising a carriage supported for generally horizontal movement between first and second positions, means for moving said carriage between said positions, an operating station at the first position of said carriage, a platform positioned at the second position of said carriage and having a work supporting surface spaced above said carriage, said platform and carriage being formed to permit movement of said carriage to its second position beneath the work supporting surface of said platform and enabling downward movement of said platform relative to said carriage in the second position of the latter, means for lowering said platform to transfer work from said platform to said carriage and for raising said platform to transfer work from said carriage to said platform, and a second operating station supported beneath the second position of said carriage in a position adjacent said platform when the latter is thus lowered.

2. Work handling mechanism comprising a carriage supported for generally horizontal movement between first and second positions, means for moving said carriage between said positions, an operating station at the first position of said carriage, a platform positioned at the second position of said carriage and having a work supporting surface spaced above said carriage, said platform having clearance openings permitting passage of said carriage to its second position beneath the work supporting surface of said platform and enabling downward movement of said

platform relative to said carriage in the second position of the latter, means for lowering said platform to transfer work from said platform to said carriage and for raising said platform to transfer work from said carriage to said platform, and a second operating station supported beneath the second position of said carriage in a position adjacent said platform when the latter is thus lowered.

3. The structure as defined in claim 2, said carriage comprising laterally spaced racks extending in the direction of movement thereof and said platform comprising rolls extending in the direction of length of said racks in offset relation to the paths of movement of said racks.

4. Work handling mechanism for use with heat treating apparatus having a furnace provided with a heating chamber and an access opening through one side wall, said mechanism comprising a carriage supported for movement through the opening between first and second positions respectively within and without the chamber, means for thus moving said carriage, a platform positioned at the second position of said carriage and having a work supporting surface spaced above said carriage, said platform having upwardly opening clearance spaces permitting passage of said carriage to its second position beneath the work supporting surface of said platform and enabling downward movement of said platform relative to said carriage in the second position of the latter, means for lowering said platform to transfer work from said platform to said carriage and for raising said platform to transfer work from said carriage to said platform, and a quenching tank supported beneath

the second position of said carriage in a position to receive said platform and the work supported thereby when the platform is thus lowered.

5. The structure as defined in claim 4, in which said carriage comprises laterally spaced racks extending in the direction of movement thereof, and in which said platform comprises rolls extending in the direction of length of said racks in offset relation to the paths of movement of said racks.

WALTER H. HOLCROFT.

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