

May 19, 1953

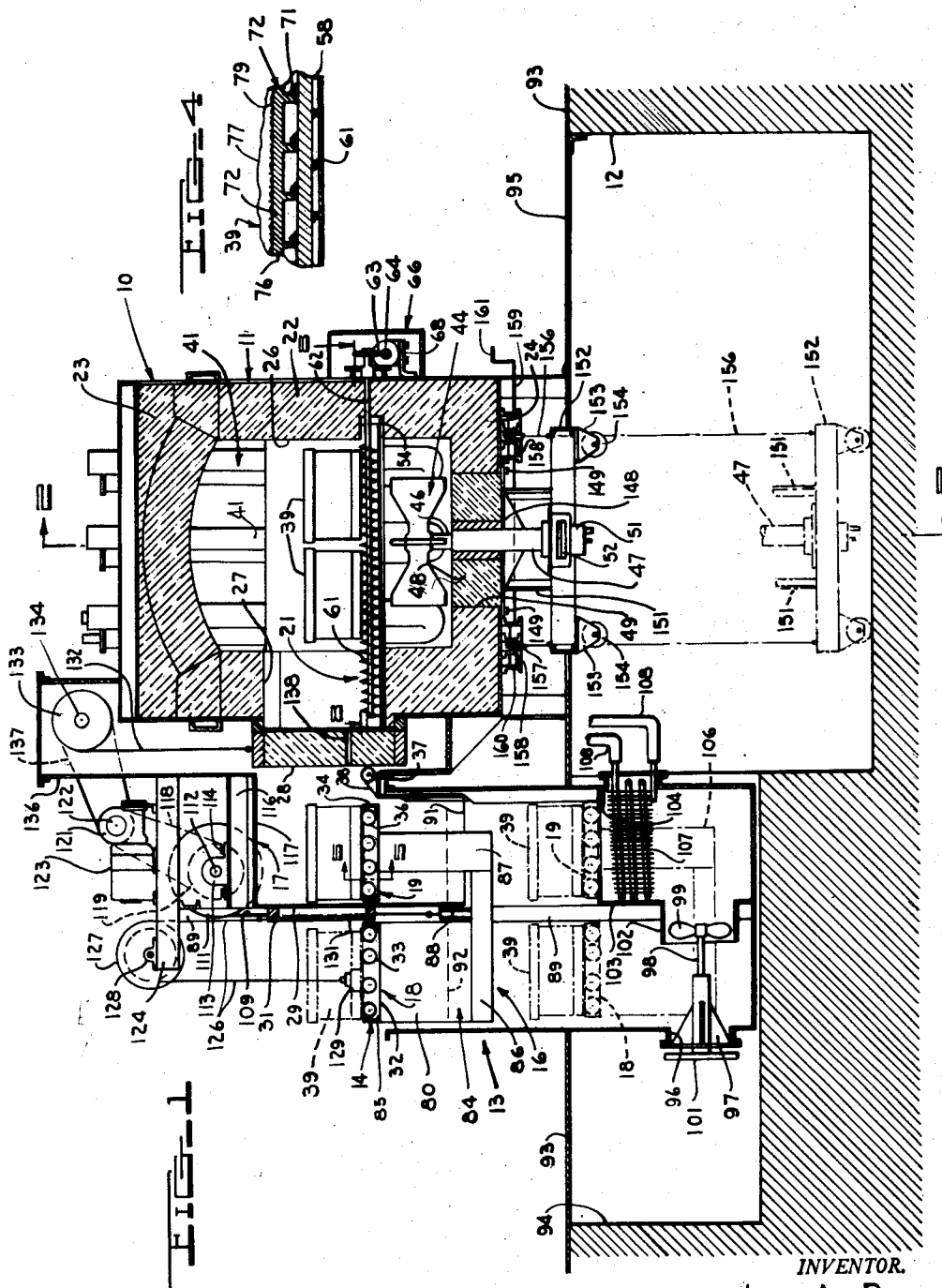
J. A. DOW

2,639,138

HEAT-TREATING APPARATUS

Filed Oct. 28, 1947

3 Sheets-Sheet 1



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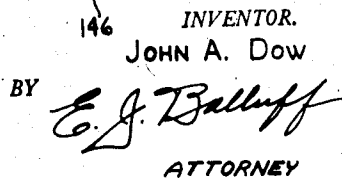
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3 Sheets-Sheet 3

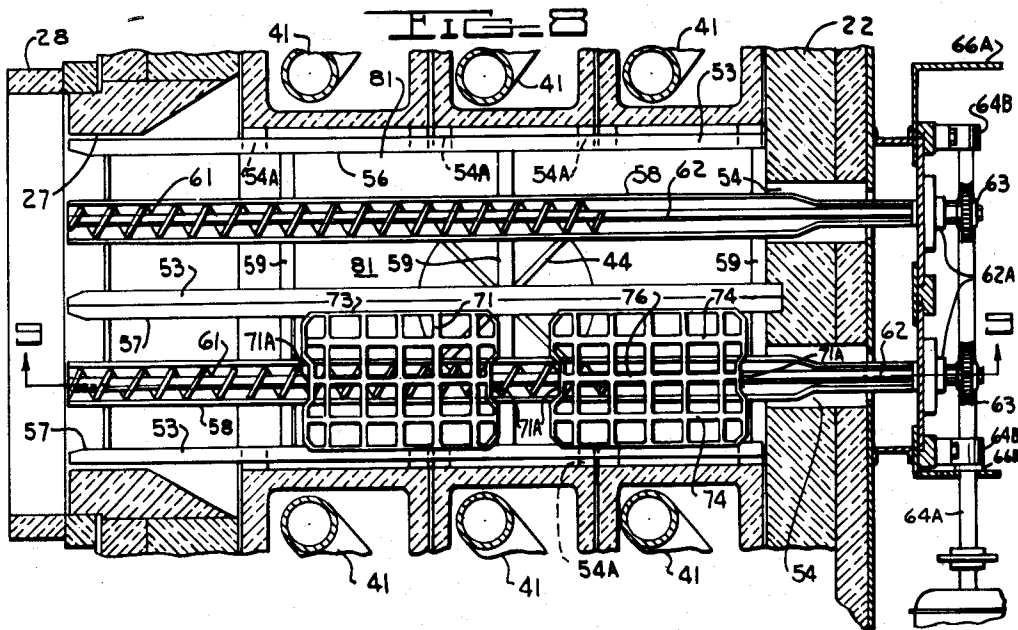
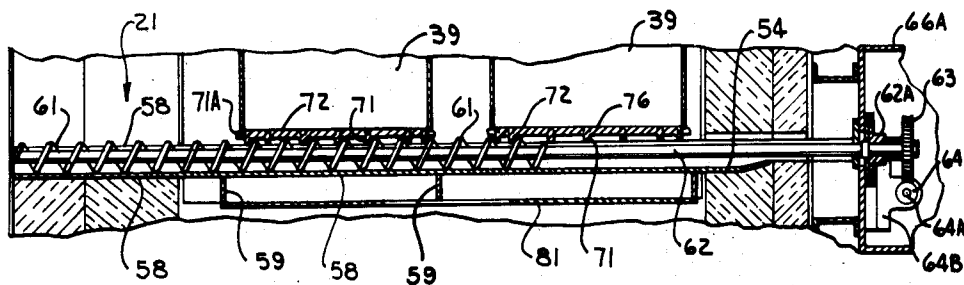


FIG. 3



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2,639,138

HEAT-TREATING APPARATUS

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Application October 28, 1947, Serial No. 782,647

4 Claims. (Cl. 266—4)

1 This invention relates to the art of heat treating metals and has particular relation to furnace apparatus employed in this art, equipped with conveyer, quenching and other mechanisms, all operatively associated and related in such manner as to improve and to simplify the practices employed in the art and to reduce the cost of operation thereof.

An object of the invention is to provide a heat treating furnace apparatus in which conveyer means is employed within the furnace for facilitating the handling of work to be processed in the furnace and for making the furnace more easily and efficiently related to other equipment which the process of heat treating may require.

Another object of the invention is to provide a quenching apparatus adaptable for association with heat treating furnaces in such manner that the whole apparatus can be efficiently utilized in the heat treating process.

Another object of the invention is to provide an improved quenching apparatus in which work can be more efficiently and qualitatively processed than in quenching apparatus heretofore employed for such purposes.

Another object of the invention is to provide a heat treating furnace apparatus with various auxiliary apparatus by which the heat treating process may be made more flexible and efficient with respect to various requirements for heat treating placed upon all of such apparatus than has heretofore been capable of realization.

Another object of the invention is to provide a construction and arrangement of the parts of a heat treating furnace mechanism whereby such parts of the furnace which may require service may be more expeditiously removed and reinstalled than was possible heretofore.

Another object of the invention is to provide a work handling apparatus comprising a conveyer and elevator mechanism by the employment of which various processes involving work handling and treatment may be more expeditiously carried out.

Other and further objects of the invention will be apparent by reference to the accompanying drawings of which there are three (3) sheets, which by way of illustration show preferred embodiments and the principles thereof and what I now consider to be the best mode in which I have contemplated applying these principles. Other embodiments of the invention embodying the same or equivalent principles may be used and structural changes may be made as desired by those skilled in the art without departing from

2 the present invention and the purview of the appended claims. I also contemplate that of the several different features of my invention, certain ones thereof may be advantageously employed in some applications separate and apart from the remainder of the features.

In the drawings:

Fig. 1 is a longitudinal sectional elevational view of a heat treating apparatus embracing the principles of the invention, with certain parts thereof illustrated diagrammatically;

Fig. 2 is a cross sectional elevational view taken in the plane of line 2—2 of Fig. 1 through the heat treating furnace embraced in such apparatus;

Fig. 3 is a fragmentary view of the structure illustrated by Fig. 1 except that Fig. 3 illustrates a modified form of conveyer and elevator mechanism employed in connection with the quenching apparatus employed in the apparatus illustrated by Fig. 1;

Fig. 4 is a fragmentary cross sectional view taken through a portion of the heat treating furnace illustrated by Figs. 1 and 2. The view is taken substantially in the plane of line 4—4 of Fig. 2 through the lower portion of the work conveying mechanism employed in the furnace;

Fig. 5 is a fragmentary cross sectional view of a portion of the conveyer and elevator mechanism illustrated by Figs. 1 and 3. Fig. 5 is taken substantially in the plane of lines 5—5 in Figs. 1 and 3.

Fig. 6 is a fragmentary cross sectional view of a portion of the modified form of conveyer and elevator mechanism illustrated by Fig. 3. Fig. 6 is taken substantially in the plane of line 6—6 of Fig. 3.

Fig. 7 is a transverse sectional view through the apparatus illustrated by Fig. 3 as the latter would appear looking downwardly in the plane of line 7—7 of Fig. 3;

Fig. 8 is an enlarged fragmentary horizontal sectional view through the furnace taken in a plane along the line 8—8 of Fig. 1; and

Fig. 9 is a fragmentary vertical sectional view taken along the line 9—9 of Fig. 8.

The heat treating apparatus disclosed by all of the figures of the drawings comprises a heat treating furnace 11, a furnace pit 12, a quenching apparatus 13, a conveyer 14, and an elevator 16, the latter comprising a portion of the conveyer mechanism 14. The furnace 11 is provided with a furnace vestibule 17 located outside the furnace 11 and through which work to be processed is moved from outside the furnace

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to the furnace and to the quenching apparatus 13. The conveyer 14 comprises a plurality of sections 18, 19 and 21 which in combination with the elevator 13 bring about and make possible such movement of the work.

The section 18 of the conveyer 14 is located on the outside of the furnace 10, the section 19 is located within the vestibule 17 and the section 21 is located inside the furnace 11. All of these conveyer sections cooperate to provide the continuous conveyer mechanism indicated at 14.

The furnace 11 comprises a plurality of heat insulating side walls 22, a top wall 23 and a bottom wall 24 within which heat treating chamber 26 is provided. One of the walls 22 has an opening 27 formed therein which provides an access opening through which work being processed may be introduced to and removed from the heat treating chamber 26. The opening 27 is provided with a heat insulating door 28 for closing the opening 27 and the communication between the heat treating chamber 26 and the interior of the vestibule 17. The vestibule 17 also is provided with an opening indicated at 29 which provides access to the interior of the vestibule 17 and a means by which work may be moved from the conveyer section 18 to the conveyer section 19 and from the section 19 to the section 18. This opening likewise has a door 31 by which this communication may be closed.

In the form of the invention disclosed by Fig. 1 the conveyer section 18 comprises a rectangular frame 32 having spaced rollers 33 rotatably mounted therein transversely with respect to the alignment of the conveyer sections 18, 19 and 21 and whereby work to be processed may be moved to and from the vestibule 17 by rolling movement upon the rollers 33. The conveyer section 19 also has a similar rectangular frame 34 having rollers 35 similarly mounted therein and upon which work being processed may be moved into and out of the vestibule 17 either through the opening 29 to the exterior of the furnace and the conveyer section 18 or through the opening 27 into the heat treating chamber 26 and upon the conveyer section 21. A roller or other suitable conveyer means 37 mounted between brackets 38 secured upon an adjacent portion of the vestibule 17 provides means for supporting the work between the conveyer sections 19 and 21.

Certain of the subject matter herein disclosed and originally claimed is now disclosed and claimed in divisional application Serial No. 261,877, filed November 6, 1951, for "Heat Treating Apparatus."

The work being processed may be placed directly upon the conveyer 14 and moved between the various sections thereof or the work may be placed in work containers such as those illustrated by the numeral 39. The furnace 11 has heating means comprising a plurality of heating elements or tubes 41 projecting into the chamber 26 from the upper wall 23 thereof along opposite side walls thereof and positioned on opposite sides of the conveyer section 21 in such manner as to provide therebetween a work processing compartment indicated in Fig. 2 by the numeral 42. These heating elements or tubes 41 may be of any type of heating means that may be employed in heat treating work and may be located in the furnace in any desired manner. For example, the heating elements 41 may

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be U-shaped tubes such as those disclosed in my copending application for United States Patent for "Heat Treating Furnace," Serial No. 670,436, filed May 17, 1946, these tubes being adapted to be supplied with a combustible mixture which when burned internally thereof heats the exterior surface thereof and from such surface the heat is transferred to the work both by radiation and convection. These tubes also are constructed in such manner as to form a gaseous fluid internally thereof and this fluid is supplied to the heat treating chamber 26 and provides the circulating medium within such chamber by which heat is transferred to the work by convection. Such circulating medium, however, may be supplied in any other manner or may be any other kind of circulating medium which it may be desirable to employ in the process of heat treating work. However, the furnace illustrated is of the controlled gas atmosphere type so that work may be processed in the chamber 26 in a controlled gas atmosphere and the furnace and its associated gas generating and supplying apparatus are constructed so as to maintain such atmosphere in chamber 26.

In the structure disclosed the heating elements 41 are provided with headers 43 by which the tubes are secured in openings 44 formed in the upper wall 23 of the furnace 11. The circulating medium within the chamber 26 which is heated by the tubes or heating elements 41 is adapted to be circulated between the heating elements and the work by means of a fan or other suitable circulating means indicated by the numeral 44. The fan 44 is located within the chamber 26 immediately above the lower wall 24 of the furnace and below the conveyer section 21. The fan 44 is rotated by a fan shaft 45 mounted in a bearing 47 extending through and mounted within a header 48 adapted to be removably positioned in an opening 49 formed in the lower wall 24. The shaft 45 is adapted to be driven for rotating the fan 44 by any suitable means, as, for example, by an electric motor, not shown. A drive unit indicated at 51 including a belt and pulley mechanism indicated at 52 may be employed for the purpose of driving shaft 45 as a result of the operation of the motor or other means referred to. When the circulating means or fan 44 is rotated within the heat treating chamber 26, it will circulate the circulating medium contained therein upwardly around the tubes 41 and downwardly across the work supported upon the conveyer section 21.

The conveyer or conveyer section 21 may be any type of mechanism suitable for moving work into and out of a furnace, although preferably the conveyer 21 comprises a frame having a plurality of spaced rails indicated at 53. (See Figs. 1, 2 and 8.) These rails, which are adapted to support the work being processed within the chamber 26 and to permit the slidable movement of such work upon the rails when the work is moved into and out of the chamber, extend across the opening 27 and across the chamber 26 from front to rear thereof. The rails 53 are supported at the front of the furnace upon the bottom wall of the opening 27 and at the rear thereof the frame is supported upon ledges indicated at 54 at the back wall of the furnace. The outside rails 53 of the conveyer section 21 frame may be supported intermediate their ends upon ledges 54a. Enough of the rails 53 may be employed to provide any desired number of parallel guide-ways for supporting work. In the structure

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shown by the drawings four of the rails 53 are provided forming guideways 56 and 57 and in which are located channels 58 which are supported between the rails 53. Transversely disposed cross frame members 59 interconnect rails 53 and channels 58. The channels 58 open upwardly to provide troughs for receiving worms or screws 61 the peripheral surfaces of which rest upon the interiors of the channels 58, thereby supporting the screws for rotational movement therein. Troughs 58 are adapted to hold a suitable lubricant for the screws 61, such as powdered graphite or mica.

Each screw 61 is provided with drive shaft extension portion 62 arranged in a reduced extension of trough 58 and which projects out of the furnace through openings formed in the rear wall where the shafts are provided with drive gears 63, each operatively associated with a drive worm 64 on the drive shaft 64a of a reversible motor driven driving mechanism indicated at 66. The driving mechanism 66 is secured in position upon the rear wall of the furnace 11 upon a bracket indicated at 68. The driving mechanism 66, except for the electric motor thereof, is enclosed in a suitable gas-tight housing 66a at the back of the furnace, the drive shaft 64a having a seal 66b between it and the housing wall where shaft 64a extends therethrough. Radial and thrust bearings 64b for shaft 64a and 62a for shafts 62 are arranged within such housing, the bearings 62a being supported to have a limited radial floating movement to provide for shifting of screws 61 due to expansion and contraction of the supporting structure thereof.

The gears 63 and driving mechanism 66 are so arranged that when the driving motor is rotated in one direction the two screws 61 will simultaneously rotate in the channels 58 in the same direction, and when the motor is rotated in the opposite direction the screws 61 will likewise rotate in the opposite direction. It will be observed that the diameters of the screws 61 are such that the threads of the screws project above the channels 58 where successive portions of the screw threads project between transverse supports 71 forming a part of the base portions 72 of the work containers 39. Two of these work containers are disclosed in Figs. 1, 2, 8 and 9 as being disposed upon each of the guideways 56 and 57 formed between the rails 53. The bases 72 also are provided with pairs of spaced longitudinal supports 73 between which are other integral longitudinal supports 74. The transverse supports 71 are notched at the ends as is indicated at 75 (Figs. 2 and 5) to provide for the extension of the supports 71 downwardly between the guides formed by the upper extremities of the rails 53.

The transverse supports 71 at the ends of the trays 72 of containers 39 have inwardly offset portions 71a at the center thereof as shown in Fig. 8 so that the minimum distance between the screw engaging portions of adjacent trays 72 (if the containers 39 were abutting each other) is slightly less than the distance between adjacent threads of screw 61 so that each tray 72 must be individually moved by screw 61 as distinguished from screw 61 moving one tray 72 and such tray 72 pushing the next adjacent tray. This arrangement is provided to prevent excess loading of the threads of screw 61 and of the screw engaging portions of trays 72.

The two longitudinal supports 73 which are formed integrally at opposite ends of the trans-

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verse supports 71 are narrower than the transverse supports 71 and are spaced from one another to such an extent that when the containers 39 are disposed upon the guideways 56 or 57 the supports 73 are maintained by the notches 75 in such position as to slidably engage the upper edges of the rails 53. The longitudinal supports 74 are of the same thickness as the transverse support 71 and are spaced inwardly from the supports 73 beyond the notches 75. Another longitudinal support indicated by the numeral 76 is disposed midway between the pairs of supports 73 and 74 for each container base 72. These latter supports extend only along the upper edge portions of the bases 72 so as to provide space therebeneath for receiving the peripheral portions of the screws 61 within the bases 72 and between the transverse supports 71 thereof.

The containers 39 also comprise metallic side walls 77 having flanges 78 around the lower edges thereof which are adapted to be seated in notches formed in the upper surfaces of the transverse members 71 immediately inside the longitudinal members 73. Grills 79 formed of wire or other suitable material are disposed inside the walls 77 in such position as to rest against the upper surfaces of the members comprising the bases 72. The grills 79 provide means for supporting work within the containers 39 in such manner that the circulating medium in the chamber 26 may be circulated downwardly over the work, through the various openings in the grills 79 and the bases 72 and between the rails 53 in response to the operation of the fan 44. In order to direct the circulating medium toward the central portion of the fan 44 there is secured upon and to the underside of the conveyer section 21 frame a plate or baffle 81 having a central opening above and in line with the fan 44.

Referring particularly to Fig. 5, it will be noted that the section 19 of the conveyer 14 which is located within the vestibule 17 also is formed in such manner as to provide a continuation of the pairs of guideways 56 and 57 for guiding the bases 72 of the containers 39 thereacross. The conveyer section 19 has rails 82 extending transversely across and forming a part of the rectangular frame 34 for providing the guideways 56 and 57. Also extending across the rectangular frame 34 between each pair of the rails 82 are channel members 83. Between adjacent sides of the channels 83 and the rails 82 are rotatably mounted the rollers 36 on which the bottom surfaces of the work baskets or containers 39 rest when the work is transported across or supported upon the conveyer section 19. The notches 75 in the bases 72 provide transverse guide means for maintaining the bases 72 between the upper extremities of the rails 82. However, the rollers 36 are located in such a position that the transverse supports 71 do not slidably engage the upper surfaces of the rails 82 when the work containers are supported upon the conveyer section 19, as these longitudinal supports 71 do slidably engage the rails 53 when the work containers are supported upon the conveyer section 21.

In the structure disclosed by Fig. 1 the conveyer section 18 located outside the vestibule 17 is constructed with a frame 32 with transverse rails and channels like the rails 82 and channels 83 illustrated by Fig. 5 and between which the rollers 33 are mounted for supporting the containers 39.

The elevator 16 by which the conveyer sections 18 and 19 are supported comprises a pair of end frames 84 each consisting of a transverse chan-

nel member 86, a vertical channel member 87 secured at one end of the member 86 and a supporting plate 80 secured at the opposite end thereof. The plates 80 are secured to opposite ends of the frame 32 of the conveyer section 18 while the channel members 87 are secured to the opposite ends of the frame 34 of the conveyer section 19. A frame member 38 projects across the space between the end frames 84 between the conveyer sections 18 and 19 and is secured rigidly into the end frames 84 at the opposite ends thereof. Guide members 89 disposed vertically with respect to the end frames 84 and midway between the conveyer sections 18 and 19 provide means for maintaining the conveyer sections 18 and 19 in the same relative position when the elevator 16 is moved upwardly and downwardly, one guide 89 being at each side of said elevator 16.

The vestibule 17 is provided with an opening 91 across the lower extremity thereof and directly beneath the conveyer section 19 when the latter is in its upper position. The opening 91 is so arranged that when the elevator 16 is moved downwardly the conveyer section 19 will pass through the opening 91 and into the space therebeneath. Disposed about the elevator 16 and having an upper open end located just beneath the normal upper operational level of the various sections of the conveyer 14 is the quenching tank 13 in which the normal level of the quenching oil or other suitable fluid is indicated by the numeral 92. The location of the opening 91 in the lower part of the vestibule 17 is such that the quenching oil level indicated at 92 is preferably above the opening 91. The lower end of the quenching tank 13 is disposed below the level of a steel plate or other suitable floor indicated at 93 and extends into a pit 94 forming a part of and communicating with the pit 12 beneath the furnace 11. Within the pit 94 the tank 13 is provided with a drive opening 96 closed by a bearing and head member 97 through which projects the drive shaft 98 of a quenching fluid circulating propeller 99. The outer end of the shaft 98 is provided with a driving pulley and belt unit indicated at 101 adapted to be driven by a motor not shown but preferably located within the pit 94. The propeller 99 is positioned in an outlet portion 102 of a quenching fluid circulating tank or means 103, the upper end of which is provided with an inlet opening 104 adapted to register with the frame 34 of the conveyer section 19 when the elevator 16 is lowered sufficiently to permit the frame 34 to seat on the upper rim of the tank 103 around opening 104. The end frames 84 of the elevator 16 move downwardly within tank 13 and on opposite sides of the ends of the tank 103 as is indicated by the dot and dash lines indicated at 106 in the structure illustrated by Fig. 1. Inside the tank 103 and just beneath the opening 104 is a finned coil indicated at 107 through which water or other suitable cooling fluid is adapted to be circulated to and from conduits 108.

It will be apparent from Fig. 1 that when the elevator 16 is lowered into the dotted line position in which the space enclosed by frame 34 registers with the opening 104 and frame 34 is seated on the rim around opening 104 that the quenching fluid in the tank 13 will be circulated downwardly over the work supported by the conveyer section 19, across the cooling coil 107 and outwardly through the outlet 102, when the propeller 99 is rotated in such direction as to discharge quenching fluid from the circulating tank 103 into the quenching tank 13 through the outlet 102. Since the outer lower frame members of tray 12 of

basket 39 have a close fit with frame 34 as shown in Fig. 5, as previously described, it will be apparent that the quenching fluid will be positively circulated through basket 39 and over the work contained therein at such time.

The elevator 16 is adapted to be moved upwardly and downwardly for moving the conveyer sections 18 and 19 between the upper normal operational level of the conveyer sections 18 and 19 and their lower position by chains or cables 109 secured at one end of the supporting member or beam 88. The chains are adapted to be wound around pulleys 111 secured at opposite ends of a shaft 112 mounted in bearings 113 secured by bolts 114 to a supporting frame 116 positioned upon an upper wall 117 of the vestibule 17. The shaft 112 is adapted to be driven alternately in opposite directions by a chain 118 operatively associated with a sprocket wheel 119 mounted on the shaft 112 and with a second sprocket wheel or pulley 121 mounted upon a drive shaft 122 of a reversible motor drive mechanism indicated at 123. The drive mechanism 123 is supported upon a frame 124 located above the frame 116 and which in turn is supported by the upper ends of guide members 89 which project out of the upper end of the quenching tank 13 and along the front of the vestibule 17 on the opposite sides of the door 31.

When the reversible drive mechanism 123 is operated so as to drive the shaft 122 in opposite directions the conveyer sections 18 and 19 will be moved upwardly or downwardly between the aforesaid normal operating and quenching positions respectively.

The vestibule door 31 is also provided with a cable or chain indicated at 126 which extends about a pulley 127 mounted in a bearing 128 secured to the frame 124 and the opposite end of which cable supports a counterweight 129. The door 31 may be opened or closed merely by taking hold of the end of the cable 126 supporting the counterweight 129 and lifting upwardly or pushing downwardly. The door 31 is provided with a vent indicated at 131 adapted to exhaust surplus circulating fluid from the interior of the vestibule 17. If a combustible circulating fluid or medium is employed, then the excess circulating fluid may be burned by lighting a match adjacent the vent 131.

The door 28 also may be opened and closed with respect to the opening 27 leading to the heat treating chamber 26 by the operation of a cable 132 secured at one end to the door and wound around a pulley indicated at 133 which is mounted upon a shaft 134 secured in frame members not shown but located in an upwardly extending part 136 of the vestibule 17. The shaft 134 is driven in opposite directions for opening and closing the door 28 by chain 137 operatively associated with a sprocket wheel not shown but located upon the end of the shaft 134 behind the pulley 133 and another sprocket wheel, also not shown, but mounted upon the drive shaft of a second motor driven reversible drive unit identical to the drive unit 123 and located by the side of drive unit 123 upon the frame 124. The door 28 also is provided with a vent indicated at 138 for the purpose of allowing surplus circulating fluid to escape from the heat treating chamber 26 into the vestibule 17.

Assuming the heat treating chamber 26 to be filled with the desired circulating medium and to be heated by the heating elements 41 to the desired temperature for heat treating the work de-

sired to be heat treated, the apparatus may be operated by placing a pair of work containers 39 filled with work to be heat treated upon the conveyer section 18. The door 31 leading to the vestibule 17 is then opened by pulling downwardly upon the cable 126 and thereafter the two work containers containing the work to be heat treated may be rolled into the vestibule 17 through the opening 29 and upon the conveyer section 19 merely by pushing on the work containers and moving the containers in the aligned guideways 56 and 57. On the conveyer sections 18 and 19 the work containers will be supported upon the rollers 33 and 36 and will be guided between the rails 82 of each of the conveyer sections by the notches 75.

Assuming the proper one of the reversible drive units 123 to have been operated for opening the door 28, the containers 39 may continue to move across the conveyer section 19 upon the rollers 37 and into contact with the screws 61 and the guide rails 53 forming the guideways 56 and 57 within the conveyer section 21. By operating the motor drive unit 66 the screws 61 now may be rotated in such manner that the containers 39 will be pulled into the heat treating compartment 26 by the engagement of the upper part of the screws 61 with the transverse supports 71 forming a portion of the base 72 of each container. During such movement of the containers 39 in response to the rotation of the screws 61, the containers will be slidably supported upon the upper edges of the rails 53 and the longitudinal support members 73. When the containers 39 have arrived at an operative position in the furnace chamber 26 the operation of the drive motor 66 may be discontinued, such as by means of an automatic stopping mechanism (not shown) associated with motor drive unit 66, and thereafter the work in the containers 39 may be heat treated by closing the doors 31 and 28 and practicing the desired heat treating process.

As is illustrated by Fig. 1, four or any desired number of heat treating containers may be positioned in the furnace at one time depending upon the size of the containers and the furnace. This may be done by simply lining up several of the containers 39 in each of the guideways 56 and 57 and upon the conveyer sections 18 and 19 and the roller 37 before starting the operation of the screws 61. Thereafter when the screws 61 engage the transverse supports of the first pair of containers 39, it is necessary only to push the remaining containers upon the rollers 33, 36 and 37 in such manner as to cause these containers to follow the first pair of containers and thereafter all of the containers will be moved inwardly with respect to the heat treating chamber 26 upon the conveyer section 21.

Referring particularly to Fig. 1 and after the work has been heated to the desired extent within the chamber 26, the heat treating process may be continued by operating the motor drive unit 66 in such manner as to reverse the rotation of the screws 61. Assuming the door 28 to have been opened by operation of one of the drive units 123, the first pair of the work containers 39 will be pushed along the rails 53 by operation of the screws 61 and outwardly into the vestibule 17. When this pair of containers has been released from the screws 61, the operation of the drive unit 66 should be discontinued and the first pair of containers 39 may then be pulled upon the rollers 37 and 36 into a position in which the bottoms of the containers 39 register with the

frame 34 and the middle pair of the rails 82 located in the conveyer section 19. Thereafter the proper one of the drive units 123 is operated in such manner as to lower the conveyer sections 18 and 19 out of the upper normal operating position and into such position that the frame 34 of the conveyer section 19 will register with the opening 104 formed in the upper end of the circulating tank 103. During the downward movement of the containers 39 the work will first engage the quenching fluid, the level of which is indicated at 92, inside the vestibule 17 and above the outlet opening 91 thereof. Such engagement may cause some evaporation of the quenching fluid but such evaporation will result in evaporated quenching fluid rising into the vestibule 17 where the same will be discharged from the vent 131 and burned in the excess circulating medium which may be escaping from such vent. The drive unit 123 employed in operating the elevator 16, however, should be of such size, capacity and speed that it will lower the elevator somewhat rapidly, and under such circumstances only a relatively small amount of quenching fluid will be evaporated during the downward movement of the containers 39 prior to the time when the frame 34 registers with the opening 104 in the circulating tank 103.

Assuming the propeller 99 to be rotating in such manner as to discharge quenching fluid from the tank 103 through the opening 102, it will be at once apparent that there will have been a downward movement of the quenching fluid through the opening 104 during the time when the containers 39 were being lowered into the quenching tank by the operation of the elevator 16. Such downward movement of the quenching fluid will tend to trap evaporated quenching fluid in the work and to carry such evaporated quenching fluid downwardly with the work until the frame 36 registers with the opening 104. Thereafter the quenching fluid will continue to circulate downwardly through the containers 39 and over the cooling coils 107, and hence the trapped and evaporated quenching fluid will tend to be carried downwardly into the tank 103 where it will be cooled and condensed upon the cooling coils 107. Thereafter the circulation of quenching fluid will continue outwardly through the opening 102 into the tank 13 and downwardly over the work within the containers 39, thereafter to be cooled for recirculation over the work by the operation of the cooling coils 107.

Notwithstanding the fact that the tank 13 is open to the atmosphere in the region around the conveyer section 18, there will be little or no escape of evaporated quenching fluid to the atmosphere. Such escape to the atmosphere of evaporated quenching fluid is prevented by the fact that the opening 91 is below the quenching fluid level indicated at 92 and consequently any evaporated quenching fluid either rises outwardly into the interior of the vestibule 17 or is carried downwardly into contact with the cooling coils 107 by the circulation of the quenching fluid after the containers 39 are immersed in the quenching fluid within the tank 13.

After the quenching fluid has been circulated in the tank 13 to an extent that is considered sufficient to properly cool the work in the containers 39, the work containers 39 are rolled from the conveyer section 19 to the conveyer section 18 by employing some means such as a hook, not shown, which may be inserted through the open upper end of the tank and into engagement

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with the pair of containers positioned on the conveyer section 19. The pair of containers by this means may be moved within the tank 13 beneath the quenching fluid level therein into a position on the conveyer section 18. By reversing the operation of the elevator driving unit 133, the elevator 12 may then be raised into a position in which the conveyer sections 18 and 19 are in normal position in alignment with the conveyer section 21 and the work containers 39 then may be removed from the conveyer 18. It will be noted that during the previously described quenching operation the door 31 was allowed to remain in closed position.

Thereafter the operation of the motor drive unit 66 may be continued in such manner as to push another pair of the containers 39 from the conveyer section 21 to the conveyer section 19, and the quenching operation previously described may be repeated until all of the containers are removed from the furnace 11 and the quenching operation has been completed for all of the work in all of the containers.

In the structure disclosed by Figs. 3, 6 and 7 there is illustrated a modified form of the conveyer mechanism 14 in which the conveyer section 48 located outside the vestibule 17 comprises conveyer means or rollers 139 positioned at an angle with respect to and intersecting other rollers 140 forming a part of conveyer means 141 which serves as a part of and an extension of conveyer section 18 and at the same time as a continuation of the main conveyer system 14. The rollers 140 are mounted transversely with respect to and upon rails 142 extending along and past the front of the vestibule 17. The conveyer 141 may extend in either direction from the vestibule to machines where work is being done that may require heat treatment or to other furnaces similar to the furnace 11 where heat treating work may be in process and which process it may be desirable to complete by bringing the work down the conveyer 14 where the quenching operation of the process may be carried out in quenching tank 13. The work containers 39 when moved upon the rollers 140 will move in parallel relation to the rails 142 and transversely with respect to the operational position of the rollers 139.

In order to be able to move work containers from rollers 140 to rollers 139 and from rollers 139 to rollers 140, the rollers 139 are mounted upon bars 143 positioned between the rollers 140 and supported on channels 144 which in turn are spaced beneath the rollers 140 and upon the upper edge surfaces of which the bars 143 are rigidly secured. The channels 144 are in turn supported at opposite ends by vertically disposed channels 146 which constitute a part of the elevator 16 and correspond to the end supports 87 employed in the structure disclosed by Fig. 1. The remainder of the structure disclosed by Figs. 3, 6 and 7 is identical to that disclosed by Fig. 1, and corresponding reference numerals are accordingly applied thereto. It will be observed that the structure disclosed by Figs. 6 and 7 may be employed for servicing several furnaces such as that indicated by the numeral 11 with one quenching tank apparatus such as that indicated by the numeral 13.

In operation the structure disclosed by Figs. 6 and 7 is identical to that disclosed by Fig. 1 except with regard to the movement of the work containers 39 within the tank 13. When the containers 39 have been positioned within the tank 13 in such position as to register with the open-

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ing 104 in the circulating tank 103 and after the work has been cooled to the desired temperature, the containers cannot be moved across the quenching tank from one conveyer section to another. It is necessary in the structure disclosed by Fig. 7 to operate the elevator in such manner as to move the containers back into the vestibule 17, and then after opening the door 31 the containers may be pulled from the conveyer section 19 to the conveyer section 18. By again operating the elevator so as to move the rollers 39 downwardly a short distance the containers then will rest upon the rollers 140 and then may be moved in either direction along the conveyer 141. Work to be processed also may be brought from other furnaces along the conveyer 141, in which event the containers are stopped upon the conveyer 18 in such position as to register with the rollers 139. Thereafter by raising the elevator 16 slightly, the work may be supported upon the roller 139, and then by opening the door 31 the work containers may be rolled through the opening 39 and upon the conveyer section 19 to be there processed as previously described.

Referring again to Fig. 1, it will be noted that the bearing 47 has secured thereto a webbed plate 148 on which the header 48 is supported and which is adapted to be removably secured to the lower wall 24 by screws indicated at 149. The plate 148 also has bars 151 secured at the upper ends thereto and at the lower ends the bars 151 are attached to a rectangularly shaped frame 152. The frame 152 has brackets 153 secured at the corners thereof within which are rotatably mounted wheels or rollers 154. Cables or chains 156 are each secured at one end to one corner of the frame 152 and a pair of the cables at one end of the frame are adapted to extend over rollers 157 and thence across the bottom of the furnace where all of the cables are wound upon rollers or drums 158. The rollers 158 are provided with an operating shaft 159 one end of which is provided with a crank 161 extending beyond the side walls of the furnace 11 and in such position as to be manually operable for rotating the roller 158. The rollers 157 and 158 are mounted between pairs of channels extending across the bottom wall 24 of the furnace, these being suitably bent to accommodate the difference in width of the rollers 157 and 158.

It will be apparent that when the screws 149 are removed it is possible to remove the fan 44 through the opening 49 by unwinding the cables 156 from the roller 158. In this manner the entire circulating means can be lowered to any desired extent below the furnace and until the frame 152 supports the entire structure at the bottom of the pit 12 upon the rollers 154. Thereafter by releasing the cables 106 from the frame 152 it is possible to move the fan structure laterally within the pit 12 until the structure is directly beneath a door 95 which is formed in a steel plate floor 93. After opening the door 95 it is possible to remove the circulating means or fan structure from the pit in any suitable manner as by the employment of a portable crane or hoist, not shown. After the fan has been repaired it is possible to replace the fan in operative position within the furnace 11 by reversing the sequence of operations previously described.

While I have illustrated and described preferred embodiments of my invention, it is understood that these are capable of modification, and I therefore do not wish to be limited to the precise details set forth but desire to avail myself of

such changes and alterations as fall within the purview of the following claims.

I claim:

1. A heat treating apparatus useful in the art of heat treating metal work comprising an elevator, quenching means for work associated with said elevator, said quenching means comprising a tank of quenching fluid beneath the normal upper position of said elevator, said tank having circulating means therein beneath the level of said quenching fluid, said elevator being provided with drive means for moving said elevator into operative position with respect to said circulating means, said circulating means being operable for circulating said quenching fluid over said work and in intimate contact therewith when said elevator is in operative position with respect to said circulating means, said elevator comprising a frame adapted to register with an opening in said circulating means and being provided with a removable work container having side walls adapted to register with said frame and a perforated bottom wall within said side walls, said frame and said side walls when in registry being adapted to direct said quenching fluid over said work during the operation of said circulating means, and to prevent circulation of said quenching fluid without passing directly in contact with said work.

2. A heat treating apparatus useful in the art of heat treating metal work comprising a plurality of heat insulating walls defining a batch type heat treating chamber, one of said walls having a vertically extending opening providing access to said chamber, a door for closing said opening, a conveyor extending within said opening and across said chamber for supporting work being processed within said chamber and for conveying said work within and without said chamber, said conveyor having a section outside said chamber comprising an elevator, a vestibule surrounding said section and communicating with said chamber through said access opening and having an access opening formed therein, a door for closing said access opening to said vestibule, said openings to said vestibule and said chamber being in line, said vestibule having a quenching opening formed therein beneath said elevator, and a quenching tank beneath said vestibule, said quenching tank having an upper open end surrounding a lower portion of said vestibule and having quenching fluid therein at a level above said quenching opening in said vestibule whereby work on said elevator may be lowered from said vestibule into and out of said quenching tank.

3. A heat treating apparatus useful in the art of heat treating metal work comprising a plurality of heat insulating walls defining a batch type heat treating furnace chamber, one of said walls having a vertically extending opening providing access to said chamber, a door for closing said opening, a work conveyor extending horizontally through said opening and across said chamber for moving said work in and out of said chamber, said conveyor having a section outside said chamber opening comprising an elevator, a vestibule surrounding said elevator and communicating with said chamber through said opening therein and having an access opening for work formed therein in line with said opening

in said furnace chamber, said vestibule having a quenching opening formed therein beneath said elevator inside said vestibule, a quenching tank, circulating means in said quenching tank arranged positively to circulate quenching liquid in a predetermined path, said elevator being provided with reversible drive means for lowering said elevator and the work supported thereon into said tank, said elevator when lowered into said tank positioning work thereon relative to said circulating means so that quenching liquid circulated thereby in its flow through its path must circulate in intimate contact with the work on said elevator, and a means operatively positioned relative to said elevator to receive work therefrom when said elevator is in its lower position in said tank so that work may be removed from said elevator while in said quenching tank.

4. A treating apparatus for metal work comprising a work conveyor having a pair of sections comprising an elevator, a vestibule surrounding one of said sections and having an access opening formed therein between and in line with said pair of sections, said sections being adapted at one elevation of said elevator to support work for movement into and out of said vestibule through said access opening, said vestibule having a quenching opening formed therein beneath said conveyor section inside said vestibule, and a quenching tank beneath said vestibule, said quenching tank having an upper open end surrounding and projecting above the lower portion of said vestibule and having a quenching fluid level therein above said quenching opening in said vestibule, alternative conveyor means adapted to conduct work along a path intersecting said conveyor section outside of said vestibule, positioning of said elevator at an elevation below said one elevation being adapted to deposit the work on said outside conveyor section at the intersection of said paths from said outside conveyor section to said alternative conveyor means.

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