June 29, 1965 N. J. ACKER 3,191,919

TRANSFER MECHANISM FOR HEAT-TREATING APPARATUS

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Fig. 1.

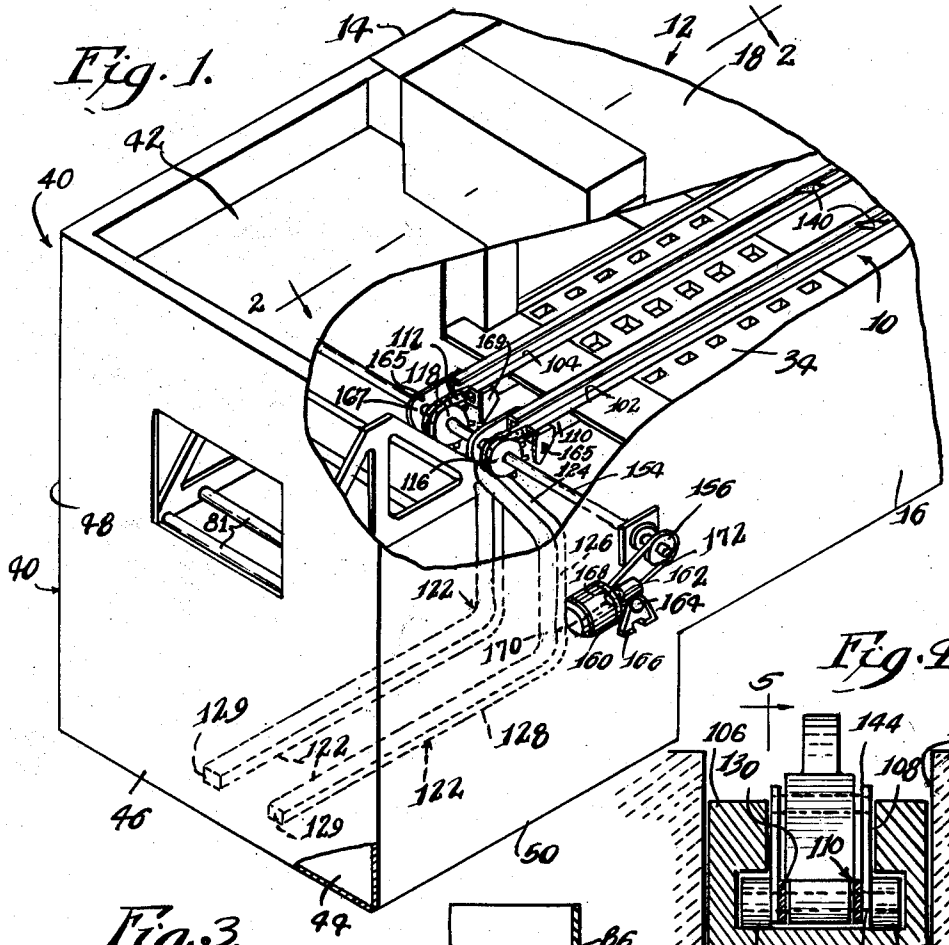


Fig. 4.

Fig. 3.

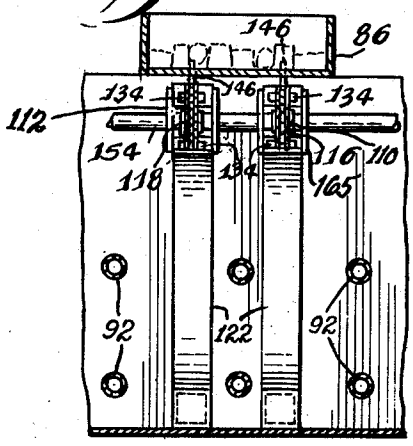


Fig. 5.

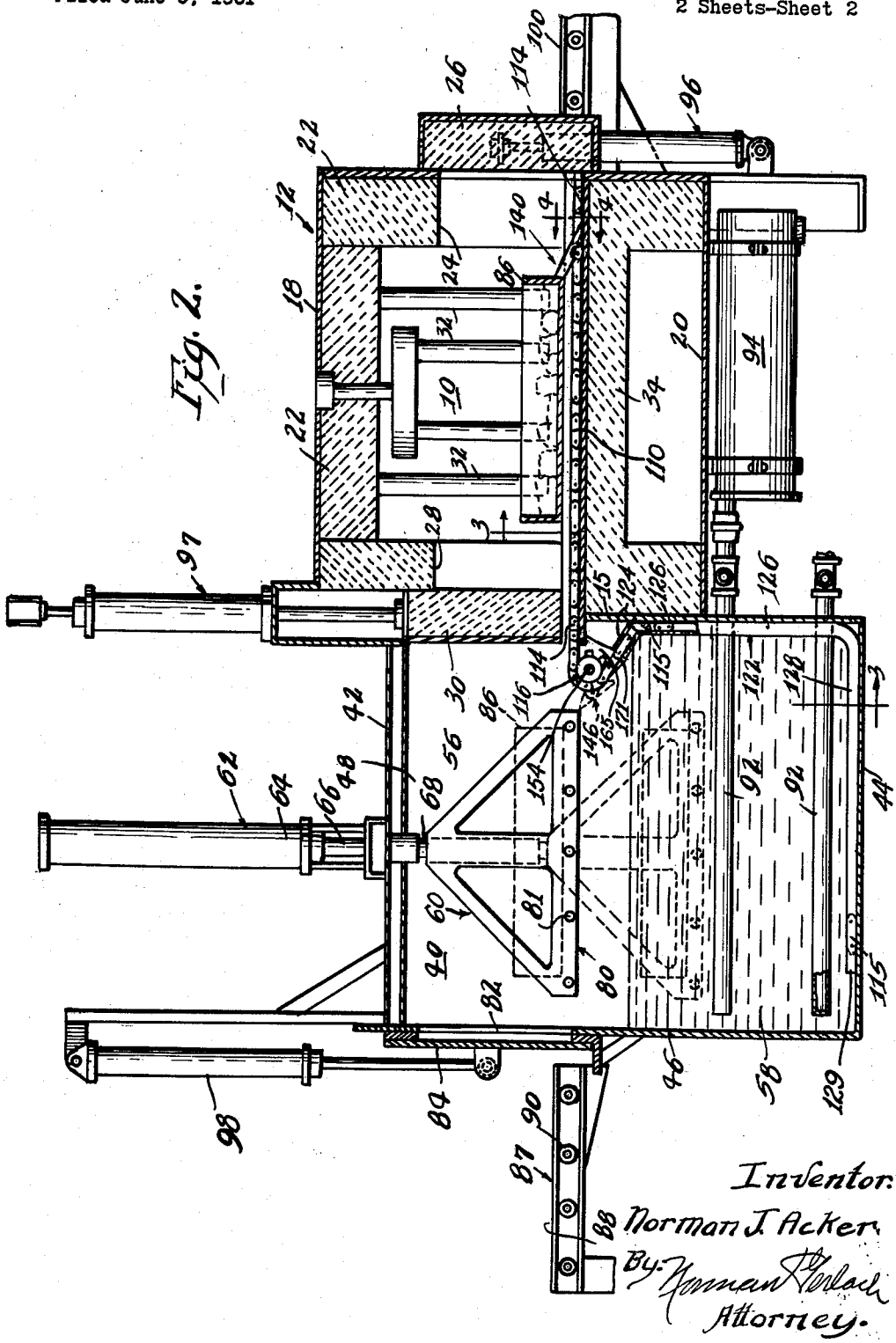
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TRANSFER MECHANISM FOR HEAT-TREATING APPARATUS

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Fig. 2.



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TRANSFER MECHANISM FOR HEAT-TREATING APPARATUS

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10 Claims. (Cl. 266—4)

The present invention relates to material-handling mechanism by means of which an article may be moved progressively along a rectilinear path between various operating stations. More specifically, the invention is concerned with a transfer mechanism whereby work or batch baskets containing miscellaneous steel parts such as screws, washers, spindles, shafts and the like which have been subjected to heat treatment operations, such as case hardening, carburizing, and carbo-nitriding, may, after heat treatment in a furnace, be transferred from the furnace to the usual quench elevator in associated relation with a quench tank and then, after the quench cycle has taken place, discharged from the quench tank onto an unloading table. It will be understood, however, that although the transfer mechanism of the present invention has been designed primarily for such use, other uses therefor are contemplated and, if desired, the mechanism may, with or without modification, be employed in the transportation of all sorts of articles along a desired path for any desired purpose. Irrespective, however, of the particular use to which the present invention may be put, the essential features thereof are at all times preserved.

The invention has been disclosed in an environment wherein a heating chamber is associated with an enclosure in communication with an adjacent quench tank having an elevator onto which the heated work, or a basket containing the work, may be transferred and lowered into the quenching liquid while being maintained in an inert non-oxidizing atmosphere. Considering such environment, it is a general object of the invention to provide a novel transfer mechanism which enables the work to be transferred from the heating chamber to the quench tank, is capable of being controlled from outside the combined heating chamber and quench tank structure, does not interfere with lowering and raising of the work or basket into and out of the quenching bath, is successively operable upon the individual units of work that are introduced into the heating chamber, and operates simultaneously to transfer a basket or unit of work from the heating chamber to the quench tank for treatment and cause ejection of a previously quenched unit of work from the quench tank to a discharge region or table.

A more specific object of the invention is to provide a transfer mechanism of this general character and having two laterally spaced impelling devices in the form of guided chain lengths, together with means for impelling the same in unison endwise in their respective paths of movement and in opposite directions in an oscillatory manner, each chain length carrying a pivoted dog mounted for swinging movement into and out of the path of movement of the work and designed for engagement with the work when the chain length is moving forwardly in an impelling direction.

The invention also comprehends or involves a novel manner of slidably supporting the work for cooperation with the pivoted impelling dogs.

A further novel feature of the invention resides in the novel manner by means of which the guided chain lengths are guided and driven.

Other objects and advantages of the invention, not at this time enumerated, will become readily apparent from

a consideration of the following description or specification.

In the accompanying two sheets of drawings forming a part of this specification, one illustrative embodiment of the invention has been shown.

In these drawings:

FIG. 1 is a fragmentary perspective view of a portion of a heating chamber and adjacent quench tank showing the improved transfer mechanism of the present invention operatively installed therein, with a portion of the furnace and quench tank wall broken away more clearly to reveal the nature of the invention;

FIG. 2 is a sectional view taken on the vertical plane indicated by the line 2—2 of FIG. 1 in the direction of the arrows;

FIG. 3 is an enlarged sectional view taken on the line 3—3 of FIG. 2;

FIG. 4 is an enlarged sectional view taken on the line 4—4 of FIG. 2; and

FIG. 5 is a sectional view taken on the line 5—5 of FIG. 4.

Referring now to the drawings in detail, and in particular to FIGS. 1 and 2, the work to be treated is heated in the heat treatment chamber **10** of a furnace **12**. The latter has side walls **14** and **16**, a top wall **18**, and a bottom wall **20**, the various walls being lined with refractory material **22** in the usual manner of construction of a heat-treating furnace. The chamber **10** is provided with an entrance vestibule **24** which is adapted to be closed by a vertically movable refractory lined door **26**. It is also provided with an exit vestibule **28** which is adapted to be closed by a vertically movable refractory lined door **30**. The atmosphere within the heat treatment chamber **10** may be regulably controlled by the application of heat thereto in any suitable manner, conventional radiant tubes **32** which extend vertically through the chamber **10** being employed for this purpose in the illustrated form of the invention. The furnace **12** is provided with a hearth **34** which cooperates with the present transfer mechanism and the nature of which will be made clear presently.

A quench tank **40** is positioned adjacent to the furnace **12** and the rear wall **15** of the latter constitutes the front wall of the former. The quench tank further includes top and bottom walls **42** and **44**, respectively, a rear wall **46** and a pair of side walls **48** and **50**.

The exit vestibule **28** for the heating chamber **10** constitutes the entrance opening for the quench tank **40**, this opening communicating with a quench tank chamber **56** which exists above the level of a body of quench liquid **58** within the tank structure.

The quench tank **40** is provided with an elevator **60** which is movable between an elevated position wherein it is disposed above the level of the liquid **58**, and a lowered position wherein it is submerged within the liquid, the movements of the elevator taking place under the control of a suitable actuator **62** including a cylinder **64** and a piston **66** in sliding relation with the cylinder, the piston being operatively connected through a piston rod **68** to the elevator **60**. The elevator **60** embodies a platform **80** including a series of rollers **81** which, when the elevator **60** is in its uppermost position, is at the level of the furnace floor or hearth **34**. The rear wall **46** of the quench tank **40** is provided with a discharge opening **82** which is adapted to be closed by a vertically slidable door **84**.

The work to be heat-treated in the furnace **12** and then quenched in the tank **40** is adapted to be contained in work baskets **86**, and the latter are adapted to be discharged from the platform **80** through the discharge opening **82** and onto an unloading table **87**. The latter is positioned adjacent to the opening **82** and includes a plat-

form 88 having a series of rollers 90 in associated relation therewith.

The liquid 58 in the quench tank is maintained at quenching temperatures by conventional heat manifolds 92 which are operatively connected to a suitable heating device 94.

The door 26 for the entrance vestibule 24, the door 30 for the exit vestibule 30, and the quench tank door 84 are all hydraulically operated, suitable piston and cylinder devices 96, 97 and 98, respectively, being employed for this purpose.

The arrangement of parts thus far described is more or less conventional in its design and construction and the illustration of FIGS. 1 and 2 is somewhat schematic. The present invention is concerned essentially with the novel construction, combination and arrangement of parts of the particular transfer mechanism by means of which the work baskets 86 are moved from the loading table which is fragmentarily shown at 100 in FIG. 2, and is disposed immediately outside the entrance vestibule 24 into the heating chamber 10, from there into the chamber 56, and finally from the chamber 56 through the discharge opening 82 onto the unloading table 88, as will now be described in detail.

Still referring to FIGS. 1 and 2, and additionally to FIG. 4, the hearth 34 is formed with a pair of laterally spaced, upwardly facing, open channel troughs 102 and 104. Each trough has seated and fixedly secured therein an elongated channel member 106 which defines or provides an internal inverted T-slot 108. As will be described subsequently in greater detail, the T-slots 108 are adapted slidably to receive therein portions of respective drive chains 110 and 112. These drive chains 110 and 112 are not of the endless chain variety, but rather they are in the form of chain lengths having terminal ends 114 which, when the chains are in their retracted positions, are disposed adjacent to or in the entrance vestibule 24, and having other terminal ends 115 which, in such retracted positions of the chains, are disposed within the quench tank 40 at or near the level of the pool of quench liquid 58 within the tank reservoir.

The ends of the channel members 106 are open and the rear ends 117 thereof slightly overhang the hearth floor, as shown in FIGS. 1 and 2. The chains 110 and 112 pass outwardly from these overhanging rear ends of the channel members 106 and extend around respective sprockets 116 and 118, from whence they pass downwardly and rearwardly on an incline, and then into the quench tank reservoir.

Two spaced parallel chain-receiving and enclosing guide tubes 122 are provided in the reservoir of the quench tank 40. These guide tubes 112 are imperforate and rectangular in cross section. They follow the contour of certain of the quench tank walls and include inclined portions 124 immediately above the level of the quench tank liquid 58, vertical portions 126 which extend along the wall 13, and horizontal portions 128 which extend along the tank bottom wall 44 and terminate in closed ends 129. The various portions of the guide tubes just described merge with one another on a generally curved bias for proper chain-guiding movement as the chains slide endwise within the tubes. The purpose of the imperforate tubes 122 is to prevent the portions of the chains 110 and 112 that are disposed in them from contacting the quench liquid 58.

The chains 110 and 112 are of more or less conventional design and each chain is comprised of conventional interlaced side links 130 (see FIGS. 4 and 5) and connecting cross pins 132. The latter carry outside rollers 134. The length of the cross pins 132 is slightly less than the width of the bottom portions of the inverted T-slots 108 in the two channel members 106 and, consequently, the rollers 134 are free to ride over such bottom portions and constrain the chains to slide easily within the channel members.

As best seen in FIG. 2, the two chains 110 and 112 are slidable within the channel members 106 and the guide tubes 122 between their full-line retracted position wherein they are shown in FIG. 2 and, as previously stated, the terminal ends 114 thereof are adjacent to the entrance vestibule 24 and the terminal ends 115 thereof are adjacent to the surface of the quenching liquid 58, and their full feed position which is shown in dotted lines in FIG. 2 and involves a position or posture wherein the terminal ends 114 are disposed adjacent to the vestibule exit 28, and the terminal ends 115 are disposed adjacent to the quench tank rear wall 46. The chains 110 and 112 are, of course, motivated by their respective sprockets 116 and 118, which are adapted to be driven selectively in opposite directions. The ends of the channel members 106 and the guide tubes 122, which are adjacent to the sprockets 116 and 118, extend sufficiently close to these sprockets that there can be no sagging or lost motion of the chains as they leave the sprockets in either direction of movement, there being no more than one full chain link span between each sprocket and the adjacent end of the channel member 106 or the guide tube 122, as the case may be. As the chains leave the sprockets over which they pass, they are thus thrust directly into the receiving ends of the adjacent channel members 106 or the guide tubes 122 to cause the chains to shift endwise in the paths of movement provided for them by these channel members and guide tubes. The chains 110 and 112 and their respective sprockets 116 and 118 thus, in effect, constitute flexible racks and are shiftable endwise, while the sprockets constitute driving pinions for the racks. It is to be noted at this point that the portions of the chains which slide in the guide tubes 122 are sealed from contact with the quench liquid in the quench tank.

Referring now additionally to FIGS. 4 and 5, the forward end regions of each chain 110 and 112 carries a pivoted work-impelling detent in the form of a dog 140 which is engageable with the work, in the case of large objects, or with the work-containing baskets, in the case of small batch articles. Each dog 140 is carried on a pivot pin 142 which extends transversely of its respective chain and is supported at its ends in carriage links 144 which are substituted in place of the regular chain side links 130, the carriage links straddling the dog (see FIG. 4). Each dog is of elongated design. It is unbalanced on its pin 142, which is to say that it is eccentrically mounted on the pin and has a short or thin arm 146 on one side of the pin presenting a flat end surface 148 for operative impelling engagement with the trailing end walls of the various baskets 86 undergoing successive introduction into the quench tank 40, and a long or thicker arm 150 having a flat end surface 152 which is adapted normally to rest, due to the influence of gravity, on the adjacent portion of its respective chain body as shown in FIG. 5, such portion constituting a reaction or stop surface for the dog. In the normal position of the dogs, when the surfaces 152 bear against the chain bodies as just described, the short arms 146 will assume a rearwardly and upwardly inclined position wherein the flat faces 148 lie in a vertical plane and are disposed above the level of the hearth 34 so that the dogs 140 project out of the T-slot 108 and the faces 148 assume an elevation wherein they are engageable with the baskets 86 for impelling purposes.

From the above description, it will be seen that as the chains 110 and 112 are shifted to the left, as viewed in FIGS. 1, 2 and 5, from their retracted position, the dogs 140 will engage the rear end wall of a basket 86 on the hearth 34 and straddling the two grooves 102 and impel the same toward the quench tank. The basket 84 will thus first slide under the impelling influence of the dogs 140 on the supper face of the hearth 34 and pass through the exit vestibule 28, then leave the hearth 34, and finally move onto the rollers 81 forming a part of

the platform 80 of the elevator 60. It will be understood, of course, that the door 30 will be operated in timed relation to the movement of the work basket 86 insofar as it will be slid first to open position to admit the basket to the quench tank and immediately thereafter to its closed position. In FIG. 2, the dotted line position of the illustrated dog 140 represents the position the dog assumes when its associated chain is in its foremost or full feed position. It is to be noted that in this position, the dog has moved over the upper end of the associated sprocket and has come to rest in a partially inverted position after having pushed the work basket 86 onto the elevator 60.

During the return stroke of the chains 110 and 112, i.e., movement toward their full retracted position, the short arms 146 of the two dogs 140 will engage the leading lower edge of the next successive work basket 86 introduced into the furnace chamber 10 through the entrance vestibule 24, and the dogs will thereby be caused inoperatively to engage or cam against the underneath side of the work basket and assume horizontal position wherein they may slide beneath the basket. As the chains 110 and 112 approach their fully retracted position, the two dogs 140 will emerge from beneath the superjacent basket at the trailing edge thereof and, under the influence of gravity, become restored to their normal upright position preparatory to reversal of the chain movement.

The operation of the apparatus is repetitious and each time a work basket 86 is pushed onto the elevator 60 by the dogs 140, the existing work basket thereon is engaged and displaced outwardly of the quench tank through the discharge opening 82.

The driving mechanism for the two chains 110 and 112 is best shown in FIG. 1. The two sprockets 116 and 118 are mounted in spaced apart relationship on a horizontal shaft 154 which extends through and is rotatably journalled in holes or openings in the side walls 48 and 50 of the quench tank 40. One end of the shaft 154 projects outwardly through the side wall 50 and carries a pulley 156. A motor and gear box assembly including an electric motor 160 and a gear reduction device 162 is pivotally mounted by means of trunnions 164 on a supporting bracket 166 which is fixedly mounted on the side wall 50 of the quench tank 40. The shaft 154 also extends through a plurality of supporting brackets 165 which are arranged in pairs, each pair straddling one of the two sprockets 116 and 118 in close proximity thereto. The brackets 165 are generally triangular in configuration and each bracket has a generally rounded corner region 167 which follows the curvature of the adjacent sprocket, and projecting corner regions 169 and 171 which are welded to the adjacent end of the associated channel member 106 and to the adjacent end of the associated guide tube 122. The brackets 165 serve to support the medial regions of the shaft 154, as well as to hold the upper ends of the guide tubes 122 in position in the quench tank. The output shaft 168 of the gear reduction device 162 carries a driving pulley 170 which is connected to the pulley 156 by an endless belt 172. The electric controls for the motor 160 form no part of the present invention and, consequently, they have not been disclosed herein. It will be understood that in a fully automatic machine, the operation of the motor will be correlated with the operation of the various piston and cylinder assemblies 96, 97, 98 and 62 to effect the desired sequence of operations.

The invention is not to be limited to the exact arrangement of parts shown in the accompanying drawings or described in this specification as various changes in the details of construction may be resorted to without departing from the spirit or scope of the invention. Therefore, only insofar as the invention has particularly been pointed out in the accompanying claims is the same to be limited.

Having thus described the invention what I claim as new and desire to secure by Letters Patent is:

1. In a heat-treating apparatus, in combination, a furnace having a heating chamber beneath which there extends a hearth, a door-controlled entrance opening, and a door-controlled exit opening to permit a work basket to be slid rearwardly along the hearth and out of the exit opening, a quench tank having a treatment chamber adjacent to said furnace and communicating with the heating chamber through said exit opening, an elevator mounted in said treatment chamber to move vertically between a lowered position and an elevated position wherein it is at the level of said hearth, mechanism to move the elevator between its elevated and lowered positions, means defining an elongated guide channel below the level of said hearth and extending between the entrance and exit openings, a rack slidable endwise in said channel, said rack being in the form of a flexible chain length, the end of the channel that is adjacent to the exit opening of the heating chamber being open to permit the flexible chain length to pass outwardly through said open end of the channel and extend into the quench tank during endwise sliding movement of the rack, detent means carried by said rack and projecting upwardly above the level of the hearth, said detent means being operatively engageable with the trailing end of a work basket disposed on the hearth when the rack moves rearwardly in the channel for sliding the basket toward and out of the exit opening and onto the elevator, and being disengaged from the said trailing end of the said work basket and sliding against the underside of a succeeding basket on the hearth when the rack moves forwardly in the channel, a pinion positioned in the treatment chamber adjacent the exit opening and in driving engagement with said rack, and means for selectively driving said pinion in opposite directions.

2. In a heat treatment apparatus, the combination set forth in claim 1 and wherein the detent means is in the form of a dog pivoted to the rack adjacent to the forward end thereof and yieldingly biased so that a portion thereof projects upwardly above the level of the hearth.

3. In a heat treatment apparatus, the combination set forth in claim 1 and wherein the detent means is in the form of a dog pivoted medially of its ends to the rack and having an arm on one side of its pivotal axis projecting normally upwardly above the level of said hearth, said dog having an arm on the other side of its pivotal axis engageable with a reaction surface on the rack to limit the extent of pivotal movement of the dog in one direction, said dog being yieldingly biased in a direction wherein the last mentioned arm thereof is in enagement with said reaction surface on the rack.

4. In a heat treatment apparatus, the combination set forth in claim 1 and wherein said detent means is in the form of a dog pivoted medially of its ends to said rack and having an arm on one side of its pivotal axis projecting normally upwardly above the level of the hearth, said dog having an arm on the other side of its pivotal axis engageable with a reaction surface on the rack to limit the extent of pivotal movement of the dog in one direction, said arms being normally operated upon by unbalanced gravitational forces whereby the dog is normally urged under the influence of gravity to a position wherein the arm of said other side of the pivotal axis is in engagement with said reaction surface on the rack.

5. In a heat-treating apparatus, in combination, a furnace having a heating chamber beneath which there extends a hearth, a door-controlled entrance opening, and a door-controlled exit opening to permit a work basket to be slid rearwardly along the hearth and out of the exit opening, a quench tank having a treatment chamber adjacent to said furnace and communicating with the heating chamber through said exit opening, said heating chamber and said treatment chamber forming an atmosphere sealed enclosure, an elevator mounted in said treat-

ment chamber to move vertically between a lowered position and an elevated position wherein it is at the level of said hearth, mechanism to move the elevator between its elevated and lowered positions, means defining an elongated guide channel below the level of said hearth and extending between said entrance and exit openings, a flexible chain length slidable endwise in said guide channel between a retracted position wherein a portion thereof is contained within the channel and another portion thereof projects outwardly into the treatment chamber beyond the end of the channel which is adjacent to said exit opening, a sprocket disposed within the treatment chamber and in operative driving engagement with the projecting portion of the chain and operative when rotated in one direction to draw the chain progressively from the channel through said end of the channel into said treatment chamber, and when rotated in the opposite direction to force the chain progressively into the channel through said end thereof, detent means on said chain, projecting upwardly above the level of the hearth and operatively engageable with the trailing end of a work basket disposed on the hearth when the rack moves rearwardly in the channel for sliding the basket toward and out of the exit opening and onto the elevator, and being disengaged from the said trailing end of the said work basket and sliding against the underside of a succeeding basket on the hearth when the rack moves forwardly in the channel, and means for selectively rotating the sprocket in opposite directions.

6. In a heat-treating apparatus, the combination set forth in claim 5 and wherein said chain is comprised of longitudinally extending chain links having their adjacent ends pivotally connected by transverse cross pins, said sprocket having teeth thereon adapted to enter between adjacent cross pins during chain-driving operations, said sprocket being disposed in tangential relationship to the axis of the guide channel and having its point of tangency with such axis disposed at a distance from the adjacent end of the channel less than the extent of a single chain link.

7. In a heat-treating apparatus, in combination, a furnace having a heating chamber beneath which there extends a hearth, a door-controlled entrance opening, and a door-controlled exit opening to permit a work basket to be slid rearwardly along the hearth and out of the exit opening, a quench tank having a treatment chamber adjacent to said furnace and communicating with the heating chamber through said exit opening, an elevator mounted in said treatment chamber to move vertically between a lowered position and an elevated position wherein it is at the level of said hearth, mechanism to move the elevator between its elevated and lowered positions, means defining an elongated guide channel below the level of said hearth and extending between said entrance and exit openings, a flexible chain length slidable endwise in said guide channel between a retracted position wherein a portion thereof is contained within the channel and another portion thereof projects outwardly into the treatment chamber beyond the end of the channel which is adjacent to said exit opening, a sprocket disposed within the treatment chamber and in operative driving engagement with the projecting portion of the chain and operative when rotated in one direction to draw the chain progressively from the channel through said end of the channel, and when rotated in the opposite direction to force the chain into the channel progressively through said end, an imperforate guide tube in said quench tank and extending from a point adjacent to the sprocket downwardly into the bottom of the quench tank, detent means on said chain, projecting upwardly above the level of the hearth and operatively engageable with the trailing end of a work basket disposed on the hearth when the rack moves rearwardly in the channel for sliding the basket toward and out of the exit opening and onto the elevator, and being disengaged from the said trailing end of the said work basket and sliding against the underside of a succeeding basket on the hearth when the rack moves forwardly in the channel, the end of the chain included by said projecting portion thereof being slidable in said guide tube, and means for selectively rotating said sprocket in opposite directions.

8. In a heat treatment apparatus, the combination set forth in claim 7 and wherein said detent means is in the form of a dog pivoted to said chain adjacent to the forward end thereof and yieldingly biased so that a portion thereof projects normally upwardly and outwardly of the channel above the level of said hearth.

9. In a heat treatment apparatus, the combination set forth in claim 7 and wherein said detent means is in the form of a dog pivoted medially of its ends to said chain and having an arm on one side of its pivotal axis projecting normally upwardly and out of the channel above the level of said hearth, said dog having an arm on the other side of its pivotal axis engageable with a reaction surface on the chain to limit the extent of pivotal movement of the dog in one direction, said dog being yieldingly biased in a direction wherein the last mentioned arm is in engagement with said reaction surface on the chain.

10. In a heat treatment apparatus, the combination set forth in claim 7 and wherein said detent means is in the form of a dog pivoted medially of its ends to said chain and having an arm on one side of its pivotal axis projecting normally upwardly and out of the channel above the level of the hearth, said dog having an arm on the other side of its pivotal axis engageable with a reaction surface on the chain to limit the extent of pivotal movement of the dog in one direction, said arms being normally operated upon by unbalanced gravitational forces whereby the dog is normally urged under the influence of gravity to a position wherein said latter arm is in engagement with said reaction surface on the chain.

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