This invention relates to conditioning apparatus in which workpieces carried by work supports are conditioned in an enclosed chamber and then are removed through an opening and moved to a predetermined position outside the chamber. In such an apparatus, a plurality of work supports are disposed in end to end abutting relation and are pushed endwise by step by step through the chamber. Upon each advance of the supports, the leading support is pushed partially through the outlet opening where it then is moved by a transfer mechanism to the aforesaid predetermined position. Due to aging and similar factors, the sizes of the supports are not uniform and hence the location of the leading support before being transferred varies from support to support.

The general object of the invention is to provide, in an apparatus of the above character, a new and improved transfer mechanism which separates the end support from the others so that the opening may be closed and also which moves each succeeding work support accurately to the predetermined position regardless of the changing locations of the supports at the time they are engaged by this mechanism.

Another object is to form the transfer mechanism as an endless conveyor under the work support and with a projection and to provide the underside of each work support with a plurality of longitudinally spaced abutments so that the projection engages one of the abutments depending upon the location of the support and then advances the support out of the opening and away from the other supports.

Another object is to provide the conveyor with a second abutment trailing behind the first so that, after the first projection passes out of engagement with the support, the second projection engages the trailing abutment and advances the support to a predetermined position.

Other objects and advantages of the invention will become apparent from the following detailed description taken in connection with the accompanying drawings, in which:

Figure 1 is a longitudinal sectional view of a heat treating furnace embodying the novel features of the present invention.

Fig. 2 is an enlarged fragmentary sectional view taken along the line 2—2 in Fig. 1.

Fig. 3 is a perspective view of a work support.

Fig. 4 is an enlarged fragmentary sectional view taken along the line 4—4 in Fig. 2.

Fig. 5 is a view similar to Fig. 4 but shows the parts in a different position.

Fig. 6 is a fragmentary view of the transfer mechanism. For purposes of illustration, the invention is embodied in a conditioning apparatus which may, as shown in the drawings, be used for heat treating metal workpieces. The furnace is formed by a walled enclosure which defines an elongated horizontal treating chamber and a baffle, which is composed of a hearth, side walls and an arch, is disposed within the chamber. The latter is heated by suitable heating tubes extending vertically through the chamber along the sides of the baffle. Fans, whose shafts project through the top wall of the furnace and are driven by electric motors, circulate the atmosphere within the chamber down along the sides of the baffle across the heating tubes, then under the baffle and up through holes in the hearth into the interior of the baffle where the work to be treated is disposed.

Herein, the workpieces are carried on trays which, as shown in Fig. 3, are cast grids with longitudinal rails and cross bars. This construction permits the atmosphere coming up through the holes in the hearth to pass through the holes in the tray and around the work. The work may be carried by the trays alone in the manner illustrated or, in the case of small workpieces, in wire mesh baskets (not shown) secured to the tops of the trays.

The trays are loaded into the furnace through an opening formed in one end wall and controlled by a power operated door and slide along the hearth which thus constitutes a guide way for the trays. Each tray abuts against the tray in front of it so that, as successive trays are loaded through the opening, the trays within the furnace are advanced step by step through the heat treating chamber. The trays may be pushed along the hearth manually or by a power transfer mechanism such as the one disclosed in my Patent No. 2,681,136.

Upon each advance of the trays, the leading tray is pushed partially through an outlet opening in the other end wall of the furnace to a position shown at A in Fig. 2. In this position, the forward portion of this tray rests on a horizontal platform secured to the end wall and forming a continuation of the hearth. As shown in Fig. 2, the platform is formed by two parallel sets of rollers spaced apart laterally so that each set supports one edge portion of a tray. The rollers of each set are journeled between two plates secured to and projecting horizontally from the end wall. A door (Fig. 1) moved by a hydraulic actuator slides up and down across the outlet opening to open and close the latter and is in the raised position when the trays are being advanced.

Beyond the platform is an elevator platform whose platform initially is level with the hearth and the platform and the leading tray from the opening to the platform opening is slid from the platform to the elevator platform (position C in Fig. 2) by a power transfer mechanism. With the tray on the elevator platform, the latter is lowered by a hydraulic actuator into a tank of quenching liquid, the tank being disposed next to and below the end wall of the furnace. The space above the quench tank, including a platform, may be enclosed by a casing so that the atmosphere both within the chamber and above the quenching liquid may be controlled. After the work has been quenched, the elevator platform is raised and the tray is slid out of the casing through a door-controlled opening and onto a platform. Even though the trays are uniform in size when manufactured, the actual size in service varies. Such variations are caused by expansion due to heating and aging of the trays. As a result, the position of the leading tray is no longer that shown in Fig. 2. Nevertheless, this tray must be moved accurately to position C on the elevator platform.

The present invention contemplates constructing and arranging the transfer mechanism in a novel manner so that it is effective to engage and advance the leading tray from tray to tray. Nevertheless, this tray must be moved accurately to position C on the elevator platform.
over, the mechanism is effective also to advance the tray the exact distance necessary to move it to the position C in spite of the variations of the position A. For this purpose, the transfer mechanism is in the form of an endless conveyor having a horizontal run 46 extending along the platform 33 under the trays 23 and moving in the direction of the advance of the trays (to the right in Fig. 1). The conveyor 40 carries two projections 47 and 48 spaced along the conveyor and the first projection engages one of a plurality of transverse abutments 49 longitudinally spaced along the tray which then is in position A, the abutment which is engaged depending upon the particular disposition of the tray. Regardless of which abutment is engaged, however, the projection 47 is effective to move the tray to an intermediate position B (Fig. 2) in which a trailing abutment 50 behind the abutments 49 is forward of the start of the run 46. After the first projection 47 passes out of engagement with the tray, the second projection 48 engages this trailing abutment 50 and advances the tray to the position C which herein is on the elevator platform 39.

Because the location of the tray in position A may vary as explained earlier, the projection 47 may engage successive trays at different points. As a result, the disposition of the tray in the intermediate position B may differ from tray to tray. In spite of this, the second projection 48 engages the tray at the identical point, that is, on the trailing abutment 50, and thus the tray is moved exactly into the position C.

In the present instance, the conveyor 40 is in the form of two endless chains 51 disposed in parallel vertical planes with the upper run 46 of the chain disposed inside of and next to one set of rollers 34 of the platform 33 (see Fig. 2). The chains extend around sprocket wheels 52 (Fig. 4) fast on a horizontal shaft 53 (Fig. 2) which extends transversely across the quenching area and through the plates 35 near the outer ends thereof. The shaft is journaled in the casing 43 and is driven by a motor 54 through a suitable speed reducer 55 and a belt 56. Each chain is looped around a guide 57 (Fig. 4), which is near the outer end of the platform 33 and is supported by a stationary bracket 58 on the latter, and around a second curved guide 59 near the inner end of the platform.

With two chains, there are two sets of projections 47 and 48, one set on each chain and the corresponding projections on the two chains being side by side. Herein, the first projections 47 are lugs which, when the conveyor chains 51 are at rest, are below the platform 33 and near the start of the run 46. The second projections 48 are dogs 40 disposed behind the lugs relative to the direction of the chain movement a distance about equal to the length of a tray 23 so that, even though the lugs engage an abutment near the front of the tray, the dogs will be behind the tray as long as the lugs engage the latter. When the lugs 47 pass out of engagement with the abutments 49, the tray momentarily is at rest and, as during the continued advance of the chains 51, the dogs 48 move up against the abutment 50.

Advantage is taken of the grid construction of the trays 23 to provide the leading abutments 49. Thus, as seen in Fig. 5, the trailing edge of the front and intermediate crossbars 25 form these abutments. Similarly, the trailing side of the rear crossbar, that is, the back of the tray proper, constitutes the abutment 50.

With the foregoing arrangement, the workpieces 10 are loaded on the trays 23 and the latter are placed in the furnace chamber 12. Then, for each heating period, a new tray is placed in the furnace and, since those trays inside the chamber abut end to end against each other, these trays are slid along the hearth 14 step by step. Upon each such advance of the trays, the leading tray is pushed part way through the exit opening 31 to the position A, the door 36 being opened for this purpose.

Next, the motor 54 is started, either manually or through a suitable automatic timing device, to produce a single cycle of the conveyor 40. The lugs 47 and dogs 48 are disposed along the lower or inactive runs of the chains 51 as shown in Fig. 4. As the chains begin their advance, the lugs 47 enter the horizontal run 46 and project up into a pair of the holes 26 in the tray. Whether the lugs project into holes near the front of the tray, near the rear or at an intermediate point depends upon the particular position of the leading tray and, as explained earlier, this in turn depends upon the varying sizes of the trays due to heating and aging.

With each lug 47 projecting up into one of the holes 26, the chains 51 advance the lugs against the abutment surfaces 49 on the crossbars 25 of these holes. As the chains continue to advance, therefore, the lugs slide the tray forward the position B (Fig. 5) in which the end of the tray is beyond the start of the run 46, this being the case regardless of which of the abutments 49 are engaged by the lugs 47. Thus the tray is out of the opening 31 and the door 36 may be closed for the next heating cycle.

When the lugs 47 pass out of engagement with the abutments 49, the tray stops in the position B while the chains 51 continue to advance and bring the dogs 48 up against the back of the tray, that is, against the trailing abutment 50. The dogs then push the tray forward to the position C on the elevator platform 39 and then, when the chains reach their starting position, the motor 54 is stopped. The elevator 38 is lowered to immerse the work carried by the tray in the quench tank 42 and, after the elevator is raised back up, the tray is removed through the door 36 disposed therein.

It will be observed that, through the combined use of the lugs 47 and the dogs 48, the latter always engage the same part of each tray, in this case the back edge of the tray. As a result, the dogs push the successive trays accurately to the position C even though the trays are presented differently to the conveyor 40. Furthermore, the leading tray is separated from the one behind it by the lugs 47 and this provides the required space for the dogs 48 to move in behind the tray. Thus, there is no necessity to provide spacers between the trays and this permits the furnace chamber 12 to be used to maximum capacity.

I claim as my invention:

1. The combination of, means defining a conditioning chamber having an outlet at one end, a plurality of work carriers, means extending through said chamber and said outlet for supporting a succession of said carriers in end to end abutment and for step by step advance along a predetermined rectilinear path to transfer the leading carrier lengthwise and partially through said outlet, each of said carriers having a plurality of transversely extending abutments spaced along the bottom thereof longitudinally of said path, a pair of endless flexible conveyors disposed in parallel vertical planes outside of said chamber and beyond said outlet and having upper runs disposed below said path and extending outwardly along the path from a point immediately below a carrier disposed in said outlet and partially removed from said chamber, means for driving said conveyors to advance said upper runs along said path in a direction away from said outlet, aligned projections on said conveyor adapted for engagement with a leading one of said abutments on said partially removed carrier, and second aligned projections on said conveyor spaced along the latter behind said first said opening 27, each moveable with the trailing one of said abutments after said first projections have transferred the carrier beyond said outlet and passed out of engagement therewith.

2. The combination of, means defining a conditioning chamber having an outlet at one end, a plurality of work carriers, means extending through said chamber and said outlet for supporting a succession of said carriers in end to end abutment and for step by step advance
along a predetermined rectilinear path to transfer the leading carrier lengthwise and partially through said outlet, each of said carriers having a plurality of transversely extending abutments spaced along the bottom thereof longitudinally of said path, an endless flexible conveyor disposed outside of said chamber beyond said outlet and having an upper run disposed below said path and extending outwardly along the path from a point immediately below the terminal carrier disposed in said outlet and partially removed from said chamber, means for driving said conveyor to advance said upper run along said path in a direction away from said outlet, a projection on said conveyor adapted for engagement with a leading one of said abutments on said partially removed carrier, and a second projection on said conveyor spaced along the latter behind said first projection and engageable with the trailing one of said abutments after said first projection has transferred the carrier beyond said outlet and passed out of engagement therewith.

3. Apparatus as defined in claim 2 in which said work carriers are grid-like trays formed by longitudinal rails and crossbars and in which said crossbars constitute said abutments whereby said projections extend up into the spaces between the crossbars and engage the latter.

4. Apparatus as defined in claim 2 in which the trailing ends of said work carriers constitute said trailing abutments engaged by said second projection whereby said first projection moves said terminal carrier away from the adjacent carrier to permit the second projection to enter behind the terminal carrier.

5. A conditioning apparatus having, in combination, means defining an elongated horizontal conditioning chamber having an outlet opening at one end thereof, a horizontal guideway disposed within said chamber and extending out through said opening and beyond the chamber, a plurality of work supporting trays supported on said guideway in end to end abutting relation to be pushed endwise step by step along the guideway thereby to move the leading tray partially through said opening, each of said trays having a first abutment adjacent the trailing edge of the tray and a plurality of second abutments disposed along the underside of the tray in advance of and different distances from the first abutment, an endless conveyor having a horizontal run extending along the portion of said guideway outside of said chamber and under said leading tray, means for driving said conveyor to advance said run away from said opening, a lug on said conveyor and engageable with one of said second abutments to advance said leading tray to a position in which said first abutment is beyond the start of said run, and a projection on said conveyor trailing behind said lug to engage said first abutment after the lug has passed out of engagement with said one second abutment and advance the leading tray to a predetermined position.

6. Apparatus as defined in claim 5 in which said lug and said projection are spaced apart a distance greater than the length of the longest one of said trays and the trailing ends of said trays constitute said first abutments engaged by said projection.

7. The combination of, means defining a conditioning chamber having an outlet at one end, a door for closing said outlet, a plurality of work carriers, means extending through said chamber and said outlet for supporting a succession of said carriers in end to end abutment and for step by step advance along a predetermined rectilinear path to transfer the leading carrier lengthwise and partially through said outlet, each of said carriers having a plurality of transversely extending abutments spaced along the bottom thereof longitudinally of said path, an endless flexible conveyor disposed outside of said chamber beyond said outlet and having an upper run disposed below said path and extending outwardly along the path from a point immediately below the carrier disposed in said outlet and partially removed from said chamber, means for driving said conveyor to advance said upper run along said path in a direction away from said outlet, and a projection on said conveyor engageable with one of said abutments on said partially removed carrier and operable when said conveyor is driven to advance the carrier beyond said outlet thereby to separate the leading carrier from the succeeding carriers and permit said door to close the outlet.

8. A conditioning apparatus having, in combination, means defining an elongated horizontal conditioning chamber having an outlet opening at one end thereof, a door selectively operable to close said opening, a horizontal guideway disposed within said chamber and extending out through said opening and beyond the chamber, a plurality of work supporting trays supported on said guideway in end to end abutting relation to be pushed endwise step by step along the guideway thereby to move the leading tray partially through said opening, each of said trays having a plurality of abutments spaced apart longitudinally of the tray, an endless conveyor having a run extending along a portion of said guideway outside of said chamber and adjacent said abutments, means for driving said conveyor to advance said run away from said opening, and a projection on said conveyor and engageable with one of said abutments to advance said leading tray out of said opening and away from the succeeding trays thereby to permit said door to close the opening.

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