

July 19, 1955

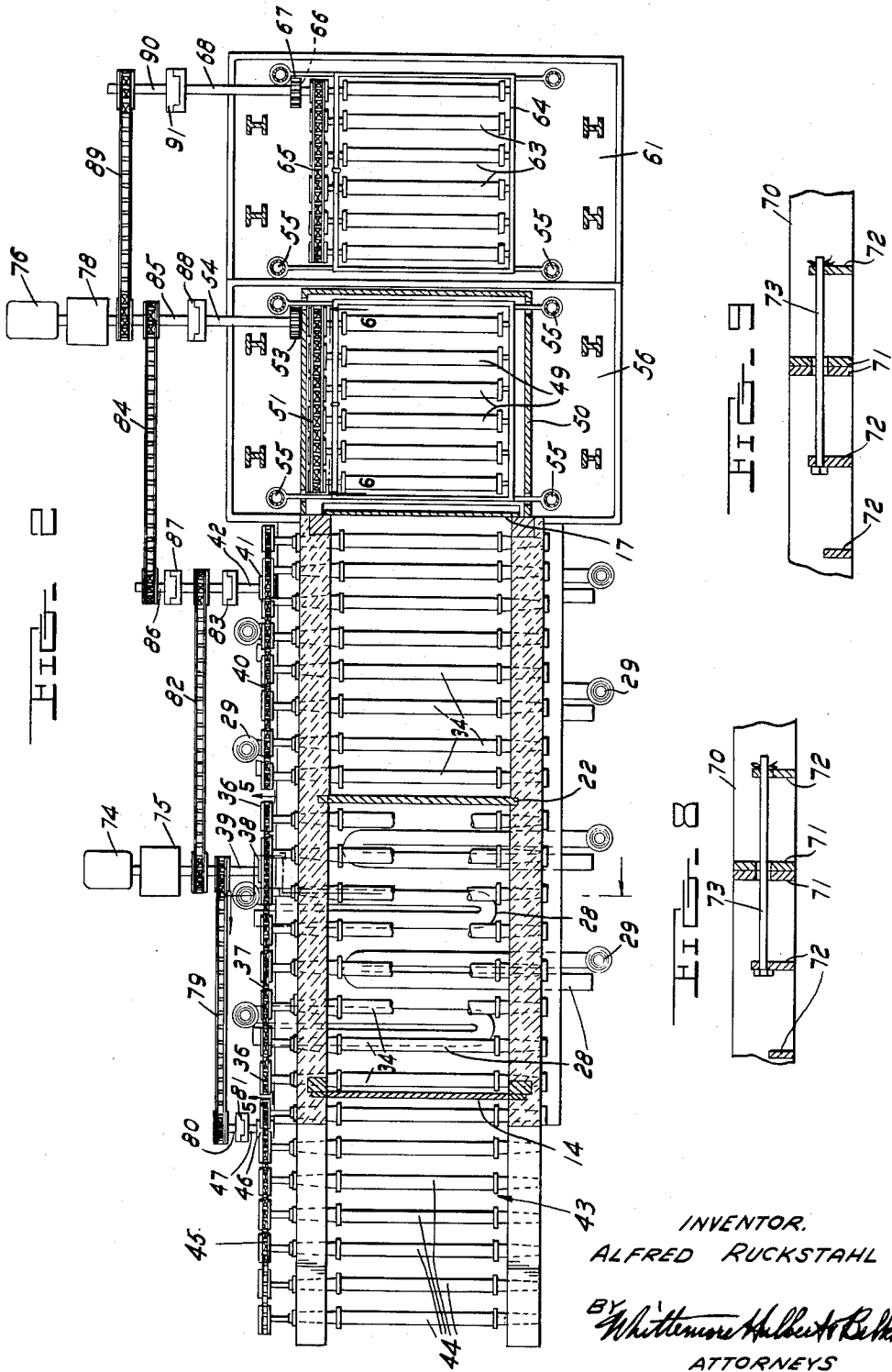
A. RUCKSTAHL

2,713,480

HEAT TREATING APPARATUS

Filed Aug. 14, 1950

4 Sheets-Sheet 2



INVENTOR.
ALFRED RUCKSTAHL

BY *Whittemore Hulbert & Beckwith*
ATTORNEYS

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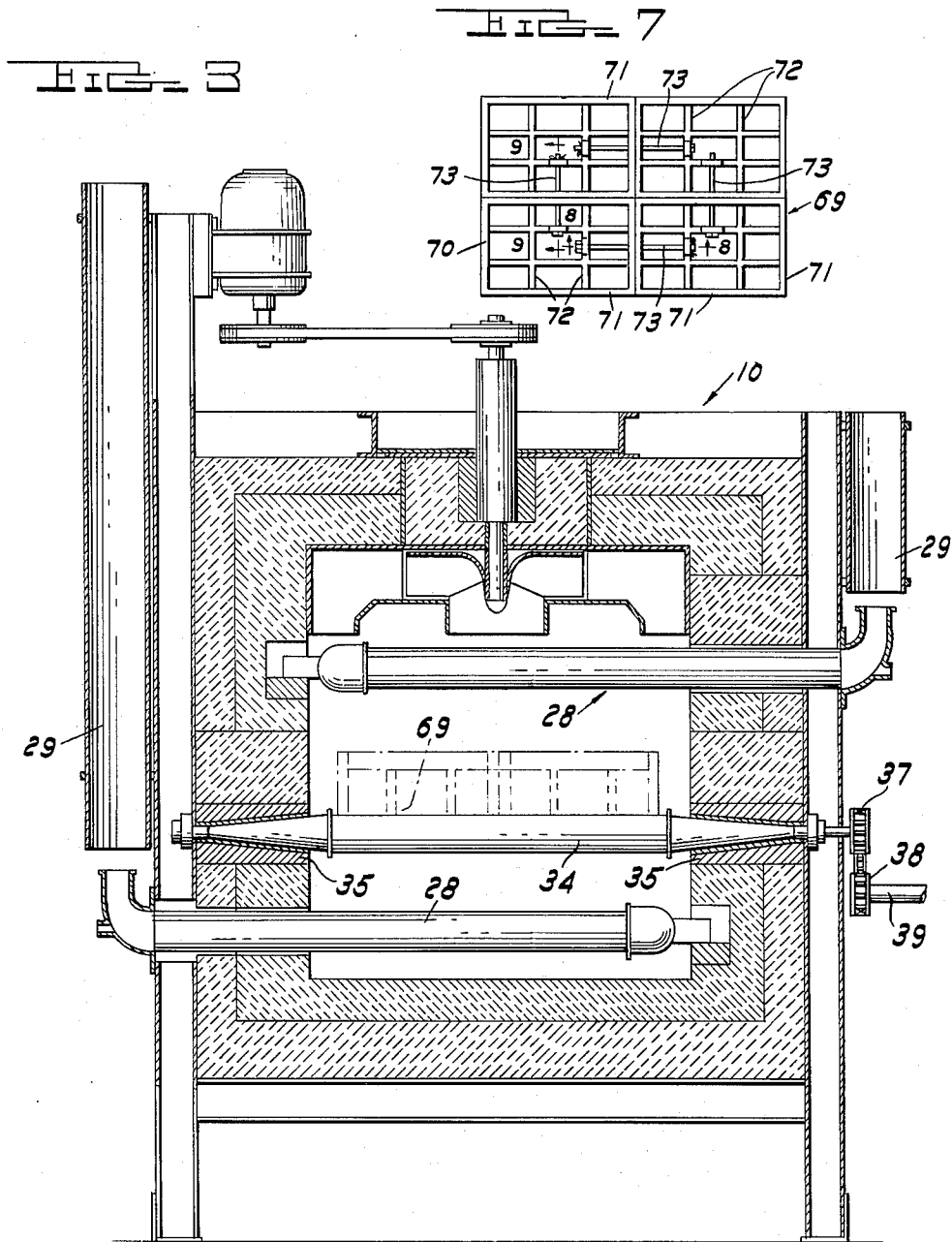
A. RUCKSTAHL

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INVENTOR.
ALFRED RUCKSTAHL
BY
Whittemore Hulbert Colknaf.
ATTORNEYS

July 19, 1955

A. RUCKSTAHL

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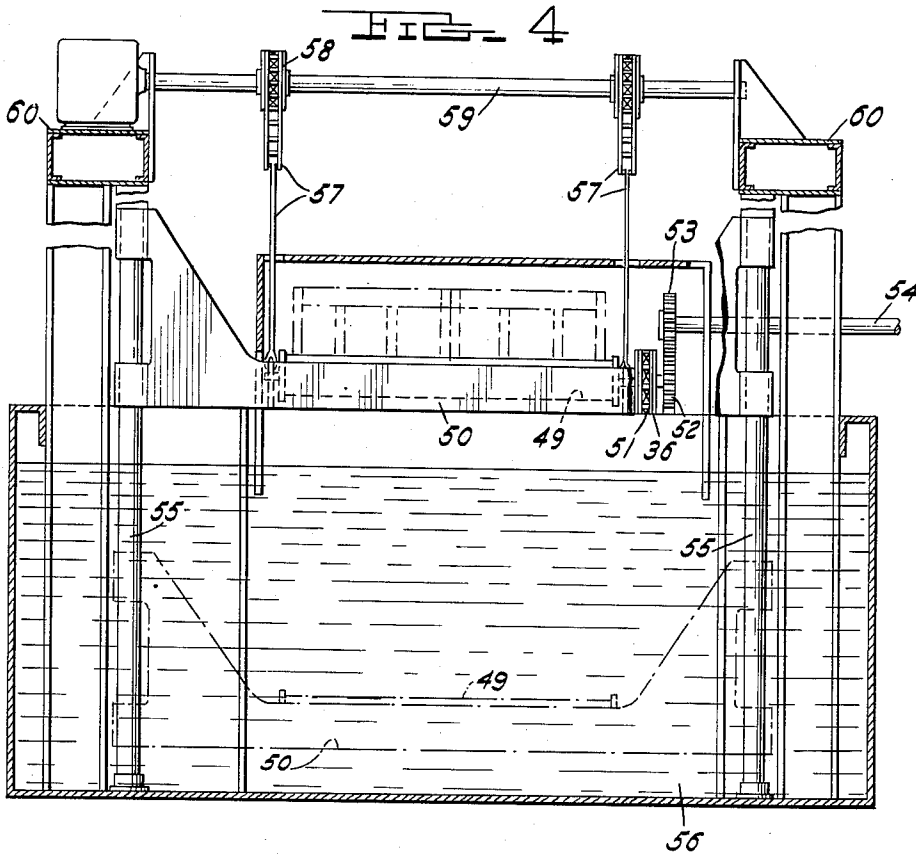
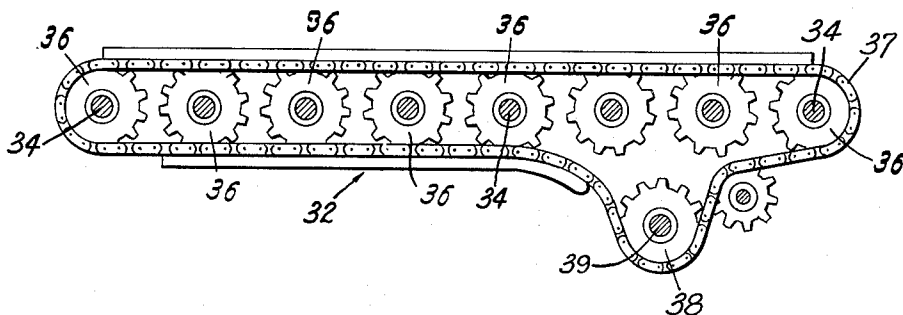


FIG. 5



INVENTOR.

ALFRED RUCKSTAHL

BY *Whittemore Hulbert & Be Manaf.*
ATTORNEYS

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HEAT TREATING APPARATUS

Alfred Ruckstahl, Dearborn, Mich.

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2 Claims. (Cl. 263—8)

This invention relates to heat treating apparatus of the type comprising an atmosphere controlled furnace through which the work to be heated is advanced.

It is an object of the invention to provide a heat treating furnace which may be divided into chambers by a door movable between open and closed positions transversely of the furnace tunnel intermediate its ends.

It is another object of the invention to provide a heat treating furnace having doors at the ends of the furnace tunnel which are movable independently of one another and the intermediate door.

It is still another object of the invention to provide a heat treating furnace wherein the work is advanced independently in the chambers. This arrangement permits the heating cycle to be carried on in the second chamber while the first chamber is being loaded and also enables unloading the second chamber without disturbing the heating cycle in the first chamber.

It is a still further object of the invention to improve generally the furnace by providing the same with rolls extending transversely of the furnace tunnel and spaced from each other longitudinally of the tunnel and by providing means for rotating the rolls to advance the work.

It is a still further object of the invention to provide trays for containing the work or the articles to be heated which are formed of connected sections and to so correlate the lengths of the sections of the trays and the spacing between adjacent rolls that during the advance of the trays by the rolls and also in the position of rest of the trays each of their sections is supported by a plurality of rolls.

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

Figure 1 is a longitudinal sectional view through heat treating apparatus embodying the invention;

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

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

Figure 4 is a rear end elevational view partly in section of the apparatus shown in Figure 1;

Figures 5 and 6 are sectional views taken on the lines 5—5 and 6—6 respectively of Figure 2;

Figure 7 is a plan view of an article supporting tray that may be used in connection with the heat treating apparatus;

Figures 8 and 9 are respectively sectional views taken on the lines 8—8 and 9—9 of Figure 7.

While the heat treating apparatus may be of various types using gas of the carburizing type, inert type, nitriding type or any of a number of types dependent upon the requirements of the customer, the apparatus selected herein for the purpose of illustrating the present invention embodies the carburizing furnace 10 adapted to contain a carburizing gas atmosphere. As shown particularly in Figure 1 of the drawings, the furnace is provided with the

elongated refractory lined tunnel 11 having the charge opening 12 at the front end and the discharge opening 13 at the rear end. The opening 12 is normally closed by the door 14 suitably supported at the front end of the tunnel for vertical movement and connected to the driving pulley 15 of suitable power means (not shown) by the chain or cable 16. The opening 13 is normally closed by the door 17 supported for vertical movement at the rear end of the tunnel and connected to the driving pulley 18 of suitable power means (not shown) by the chain or cable 19.

For dividing the interior of the tunnel 11 into the first and second chambers 20 and 21 respectively, there is the door 22 supported intermediate the ends of the tunnel for vertical movement between open and closed positions in the tunnel and the refractory block 23 secured to the bottom wall of the tunnel and upon which the bottom edge of the door is adapted to seat. The top of the door 22 is connected to the driving pulley 24 by the chain or cable 25, and the latter, together with the pulley, are enclosed in the housing 26 for preventing the escape of the gas contained in the tunnel. The housing is open at the bottom in communication with the slot 27 in the top wall of the tunnel, both the housing and the slot being of a size to receive the door. The specific power means for operating the driving pulleys 15, 18 and 25 may be of any suitable type, such as the electric motor and speed reducer type, the fluid pressure operated cylinder type or some other type with each power means independent of the others to enable operation of the three driving pulleys and consequently the three doors independently of one another.

Suitably supported within each chamber 20 and 21 are upper and lower banks of horizontally extending U-tubes 28. As shown in Figure 2 of the drawings, the U-tubes extend across the tunnel, and are of a type in which active combustion of oil or gaseous fuel mixture occurs to produce radiant heat. Referring now to Figure 3 of the drawings, it will be noted that one leg of each of the U-tubes communicates with the stack 29 through which the products of combustion are discharged.

The carburizing gas is supplied to each of the chambers 20 and 21 through the supply conduits 30 and 31 respectively.

The furnace tunnel 11 is provided with a roller hearth extending from the charge opening 12 to the discharge opening 13. The hearth comprises the groups 32 and 33 of parallel like rolls 34 which extend transversely of the tunnel 11 and are spaced from one another lengthwise of the tunnel, the group 32 of rolls being located in the first chamber 20 and the group 33 of rolls being located in the second chamber 21. As shown in Figure 3 of the drawings, the opposite ends of the rolls 34 are tapered and are journaled in the bearings 35 which are water cooled and supported in the opposite side walls of the tunnel.

The rolls 34 have secured to their ends at one side of the furnace the like sprockets 36. As shown in Figure 5 particularly the sprockets connected to the rolls of the group 32 are connected by the chain 37 and the latter is engaged by the drive sprocket 38 which is mounted on the drive shaft 39. The sprockets which are secured to the rolls of the other group 33, are connected by the chain 40 which is engaged by the drive sprocket 41 mounted on the drive shaft 42.

With the above construction, the interior of the furnace is readily accessible in the event that inspection or repairs are required.

The group 43 of rotatable rolls 44 is supported at the loading end of the furnace and outer side of the door 14 in the horizontal plane of the roller hearth. The rolls 44 are parallel to and of the same diameter as

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the rolls 34. The rolls 44 are connected by the chain 45 which is at the same side of the furnace as the chains 37 and 40 and which engages sprockets secured to the ends of the rolls, these sprockets being the same as the sprockets 36. The chain 45 is engaged by the drive sprocket 46 which is mounted on the drive shaft 47.

The arrangement of drive shafts and chains for driving the groups 33 and 43 of rolls through the sprockets is the same as that for the group 32 of the rolls.

The group 48 of rotatable rolls 49 is supported on the elevator platform 50 which is positioned at the unloading end of the furnace and outer side of the door 17. The rolls 49 are of the same diameter as and extend in parallel relation to the rolls 34 and are supported in the raised position of the elevator platform in the horizontal plane of the roller hearth of the furnace. As shown in Figure 6, the rolls are connected by the chain 51 which is at the same side of the furnace as the chain 40 and which engages sprockets secured to the ends of the rolls, these sprockets being the same as the sprockets 36. The roll most remote from the door 17 has also secured thereto the gear 52 which is in mesh with the drive gear 53 thereabove when the elevator platform is raised to its upper-most position. The drive gear is mounted on the drive shaft 54.

The elevator platform 50 is guided by the vertical posts 55 extending downwardly into the quenching tank 56. When the elevator platform is in the upper-most position shown by full lines in Figure 4 the rolls 49 are located in the horizontal plane of the roller hearth of the furnace and when the elevator platform is in lowered position as shown by broken lines the rolls are submerged in the quenching bath in the tank. The elevator platform may be lowered into and raised out of the quenching liquid forming the bath by suitable means such as the chains or cables 57 and the driving sprockets 58. The sprockets are secured to the reversible drive shaft 59 supported on the frame 60 above the elevator platform and connected to a suitable source of power, such as an electric motor through a speed reducer. Inasmuch as the drive gear 53 meshes with the upper side of the gear 52, the gears are disengaged during the initial downward movement of the elevator platform and re-engaged during the final portion of the upward movement of the elevator platform.

After quenching the work, it is frequently desirable to wash the work by submerging the same in a suitable liquid which as shown in the present instance is contained in the tank 61 at the rear side of the quenching tank 56. For supporting the work while it is being immersed in and raised from the washing bath I have provided the group 62 of rotatable rolls 63 on the elevator platform 64 which is of the same construction as the platform 50 and is raised and lowered in the same manner and also guided during its vertical movement in the same manner. The rolls 63 are of the same diameter as the rolls 34 and extend in parallel relation thereto and are supported in the raised position of the elevator platform 64 in the horizontal plane of the roller hearth of the furnace. The rolls 63 are connected by the chain 65 which is at the same side of the furnace as the chain 51 and which engages sprockets secured to the ends of the rolls, these sprockets being the same as the sprockets 36. The roll most remote from the quenching rolls 49 has also secured thereto the gear 66 which is in mesh with the drive gear 67 thereabove when the elevator platform 64 is raised to its upper-most position. The drive gear is mounted on the drive shaft 68.

As illustrated in Figures 7 to 9 inclusive, the tray 69 for supporting the work or articles to be heat treated is made up of the plurality of like relatively small light weight sections 70 each of which has the peripheral side walls 71 and the transversely extending supporting

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bars 72. The sections are flexibly secured together by the rods 73 which extend through adjacent side walls and the bars closest to these side walls, there being clearance between the rods and the peripheries of the apertures in the side walls to provide for a certain amount of flexibility. The lengths of the sections 70 and the spacing of all of the rolls 44, 34, 49 and 63 are correlated so that during the advance of the trays by the rolls each section is supported by a plurality of the rolls. This is also true when the trays are in their positions of rest. As a result the trays may be of considerably lighter weight than heretofore considered practical so that heating of the work is facilitated and the stresses to which the trays are subjected throughout the entire heat treating operation are materially reduced and also the initial as well as the replacement costs of the trays is decidedly reduced.

For the purpose of driving adjacent groups of rolls in unison or synchronism, suitable apparatus is provided. This apparatus as diagrammatically illustrated in the present instance comprises the electric motor 74 connected to the drive shaft 39 through the speed reducer 75 and the electric motor 76 connected to the shaft 85 through the speed reducer 78. It also comprises the chain 79 extending around a sprocket on the drive shaft 39 and a sprocket on the shaft 80 which is adapted to be connected to the drive shaft 47 by the clutch 81. There is also the chain 82 reaved around a sprocket on the drive shaft 39 and a sprocket rotatable on the drive shaft 42 and adapted to be connected to the drive shaft by the clutch 83. The electric motor 76 is adapted to be connected to the drive shaft 42 by the chain 84 reaved around a sprocket on the shaft 85 and a sprocket on the shaft 86 which latter shaft is adapted to be connected to the shaft 42 by the clutch 87. Also, the electric motor is adapted to be connected to the drive shaft 54 by the clutch 88. In addition, the electric motor is adapted to be connected to the drive shaft 68 by the chain 89 reaved around a sprocket on the shaft 85 and a sprocket on the shaft 90 which is adapted to be connected to the drive shaft 68 by the clutch 91.

In operation, assuming that a tray 69 is located on the group 43 of the loading rolls 44, the door 14 is raised to open the charge opening 12, the driving and driven members of the clutches 81 and 83 are engaged and disengaged respectively and then the electric motor 74 is started to drive the drive shaft 47 of the group 43 of loading rolls through the clutch 81 and the chain 79 and the drive shaft 39 for the group 32 of the rolls 34 in the first chamber 20. As a result the loading rolls 44 and the rolls 34 in the first chamber are driven in unison and the tray is advanced into the first chamber and when it reaches the predetermined position in the first chamber, operation of the electric motor is discontinued. The flow of air into the first chamber through the charge opening is minimized by the flow of carburizing gas from the first chamber through the charge opening. Then the door 14 is closed. After the tray has been in the first chamber a predetermined length of time the intermediate door 22 is raised to open position and the driving and driven members of the clutch 83 are engaged, the driving and driven members of the clutch 81 are disengaged and the driving and driven members of the clutch 87 are also disengaged, after which the electric motor 74 is again started to drive the drive shaft 39 for the group 32 of rolls 34 in the first chamber and the drive shaft 42 of the group 33 of the rolls 34 in the second chamber in unison to advance the tray in the first chamber into the second chamber. When the tray has reached a predetermined position in the second chamber the operation of the motor 74 is discontinued. After this tray advance, the intermediate door is lowered to closed position. Then in the normal operation of the furnace a tray upon the group 43 of loading rolls 44 is advanced into the first chamber in

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the manner above described. After the tray in the second chamber has remained a predetermined length of time the door 17 is raised to open the discharge opening 13 and the drive and driven members of the clutches 87 and 88 are engaged and the drive and driven members of the clutches 83 and 91 disengaged after which the electric motor 76 is started to drive the drive shafts 42 and 54 and as a result the rolls 34 in the second chamber and the quenching bath rolls 49 in unison thereby advancing the tray from the second chamber onto the quenching bath rolls 49. When the tray is located in a predetermined position on the quenching bath rolls the operation of the electric motor 76 is discontinued and the elevator platform 50 is lowered into the quenching bath. During the time the door 17 is open flow of air into the second chamber 21 through the discharge opening is minimized by the flow of carburizing gas from the second chamber through the discharge opening. The door 17 is then closed. After the tray in the first chamber 20 has remained a predetermined length of time it is advanced into the second chamber 21 in the manner above described. After the work or articles in the tray on the quenching bath rolls 49 have been quenched the tray is then advanced in the raised position of the quenching bath platform to the washing bath rolls 63, this being accomplished by disengaging the drive and driven members of the clutch 87 and engaging the drive and driven members of the clutches 88 and 91 and again starting the electric motor 76 which drives the drive shafts 54 and 68 and as a result drives the quenching bath rolls 49 and the washing bath rolls 63 in unison. When the tray has reached a predetermined position on the washing bath rolls the operation of the electric motor 76 is discontinued and the washing bath platform 64 is lowered and then raised. Then the tray in the second chamber after it has remained in this chamber a predetermined length of time is advanced to a predetermined position on the quenching bath rolls 49 in the manner as above described. Preferably both of the elevator platforms 50 and 64 are lowered at the same time. Finally after the washing bath platform 64 has been raised the drive and driven members of the clutches 88 and 91 are disengaged and engaged respectively and the electric motor 76 is again started to drive the drive shaft 68 only and advance the tray off the washing bath rolls 63.

What I claim as my invention is:

1. Heat treating apparatus comprising a furnace having a horizontally disposed tunnel provided with charge and discharge openings at its opposite ends to permit passing an article receiving tray therethrough and having means for heating the interior of said tunnel, doors for the charge and discharge openings being supported for movement between open and closed positions, means for advancing the tray through said tunnel comprising a first group of rolls, a second group of rolls located ad-

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5 adjacent the discharge opening of said tunnel exteriorly thereof, all of said rolls extending transversely of said tunnel and spaced apart longitudinally thereof, a quenching tank located beneath said second group of rolls, means supporting said second group of rolls for vertical movement as a unit into and out of said quenching tank, power means for thus moving said second group of rolls, and means for selectively operatively connecting said drive means to said first and second groups of rolls to drive said first and second groups of rolls independently and in unison, said last-named means including a driving element and a cooperating driven element associated with said second group of rolls and engageable with said driving element, said elements being disengageable upon lowering of said second group of rolls into said quenching tank.

2. Heat treating apparatus comprising a furnace having a horizontally disposed tunnel provided with charge and discharge openings at its opposite ends to permit passing an article receiving tray therethrough and having means for heating the interior of said tunnel, doors for the charge and discharge openings being supported for movement between open and closed positions, means for advancing the tray through said tunnel comprising a first group of rolls, a second group of rolls located adjacent the discharge opening of said tunnel exteriorly thereof, all of said rolls extending transversely of said tunnel and spaced apart longitudinally thereof, means forming a treating zone located beneath said second group of rolls, means supporting said second group of rolls for vertical movement as a unit into and out of said treating zone, power means for thus moving said second group of rolls, and means for selectively operatively connecting said drive means to said first and second groups of rolls to drive said first and second groups of rolls independently and in unison, said last named means including a driving element and a cooperating driven element associated with said second group of rolls and engageable with said driving element to be driven by the latter in the raised position of said second group of rolls, said elements being disengageable upon lowering of said second group of rolls into said treating zone.

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