Nov. 23, 1965 N. J. ACKER 3,219,330

FURNACE TRANSFER MECHANISM

Filed May 10, 1962 2 Sheets-Sheet 1

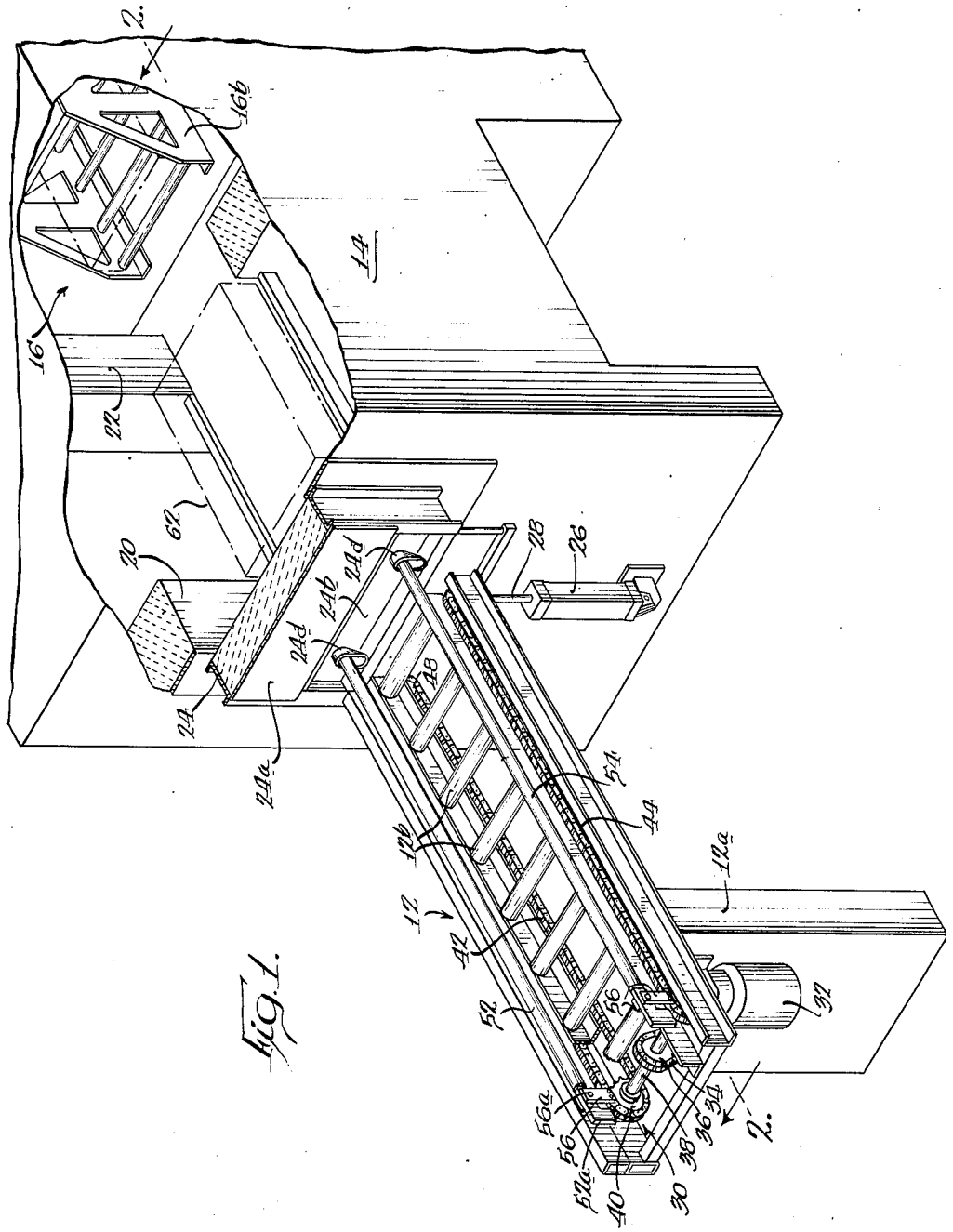


Fig. 1.

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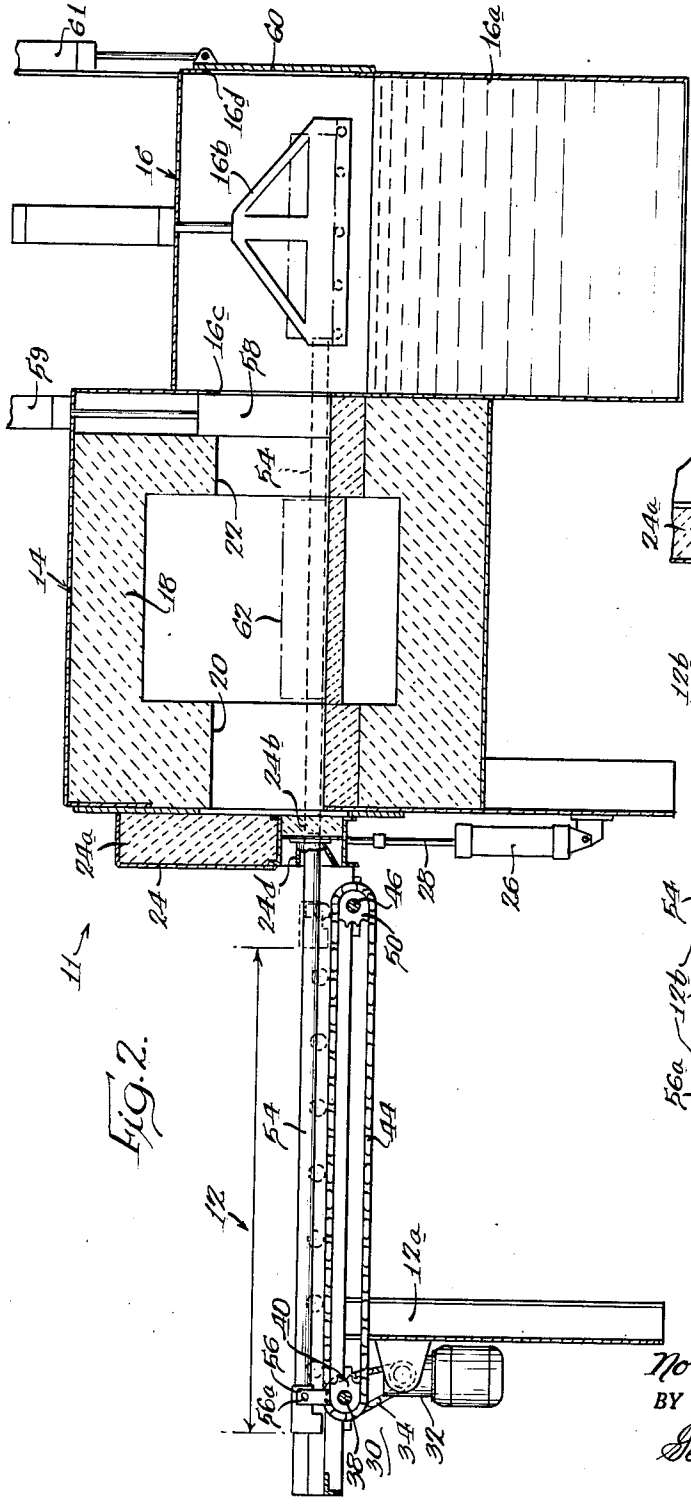


Fig. 2.

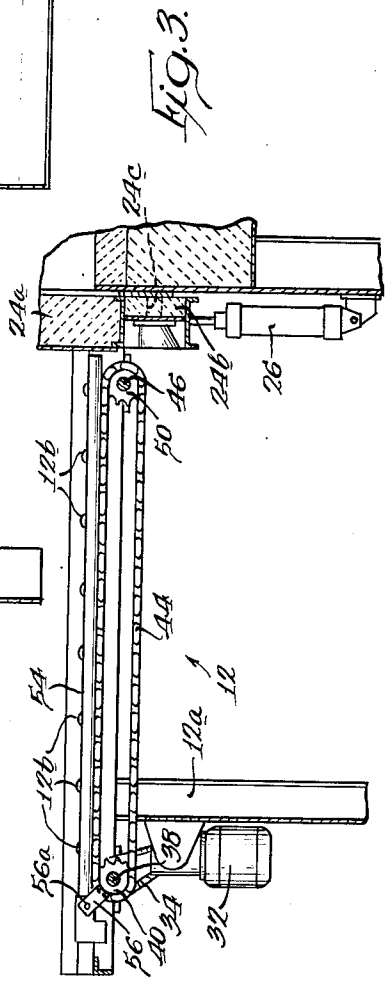


Fig. 3.

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FURNACE TRANSFER MECHANISM

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7 Claims. (Cl. 266—4)

The present invention relates to heat treating apparatus, and more particularly to work transfer apparatus for use in a heat treating furnace.

The invention is concerned with the type of furnace in which a gas or atmosphere is maintained within the furnace during the heat treating cycle. At the end of the heat treating cycle, and prior to exposing the work to the air outside of the furnace, the work is quenched. It is desirable that the parts or work be maintained in the furnace atmosphere until they have been quenched, cooling the parts to a safe temperature. The problem solved by the instant invention relates to the transfer of the parts from the heat treating portion of the furnace to the quench tank while maintaining the furnace atmosphere.

The design of such a transfer mechanism is complicated by the high temperatures present within the heat treating enclosure. Any complex conveyors or mechanisms positioned within the heat treating enclosure and subjected to high temperatures would malfunction and cease to operate in a relatively short time. In Acker et al. U.S. Pat. No. 2,965,369 there is disclosed a transfer mechanism for heat treating apparatus in which reciprocating pusher members are employed to move work to be heat treated into the furnace and from the interior of the furnace into the quenching chamber. In this prior apparatus the portion of the transfer mechanism which advances the work from the heat treating enclosure to the quench chamber extended through an opening in the wall of the furnace enclosure. This portion of the transfer mechanism, which is termed a pusher element, reciprocated forwardly and backwardly to move the work through the furnace.

While such a mechanism was very satisfactory, there are instances in which it is necessary to maintain the furnace enclosure completely sealed from the outside atmosphere. The presence of any connecting member extending through the wall of the furnace at all times tends to make the sealing of the furnace enclosure difficult.

It is therefore an object of the present invention to provide a transfer mechanism which requires no opening through the furnace wall.

It is a further object of the present invention to provide an improved transfer mechanism for a heat treating furnace wherein the mechanism is completely external of the furnace enclosure.

It is an additional object of the present invention to provide a work transfer device for a furnace which is insertable through an opening in the furnace door to move the work from the furnace enclosure into the quench chamber.

It is an additional object of the present invention to provide a furnace having an entrance door through which the work transfer member is insertable to advance the work from the heat treating chamber into the quench chamber.

Further objects and advantages of the present invention will become apparent as the following description proceeds and the features of novelty which characterize the invention will be pointed out with particularity in the claims annexed to and forming a part of this specification.

For a better understanding of the present invention reference may be had to the accompanying drawings in which:

FIG. 1 is a cutaway perspective view of a heat treatment apparatus showing the improved transfer mechanism of the present invention;

FIG. 2 is a sectional view taken along line 2—2 of FIG. 1; and

FIG. 3 is a fragmentary sectional view taken along line 2—2 of FIG. 1 showing the work transfer mechanism in its completely withdrawn position.

The present invention is concerned with a work transfer mechanism for use in a controlled atmosphere type of heat treatment apparatus. The transfer mechanism includes a longitudinally movable member which is adapted for insertion into the furnace enclosure to move parts contained therein from the furnace enclosure into the quench chamber while maintaining the atmosphere within the furnace enclosure during the transfer of work to the quench chamber. The entrance door for the furnace is provided with at least one small opening through which an elongated rod is insertable to engage the work in the furnace. This door for the furnace is movable between three different positions. These positions are, (1) an open position which it occupies during the loading of parts into the furnace enclosure, (2) a full closed position which it occupies during the heat treating cycle, and (3) an intermediate position wherein the door is partially raised to expose the openings through which the work transfer rod is inserted into the furnace. Through the use of the multiple position door and the movable transfer rod insertable through the door, it is possible to maintain a very complete seal for the enclosure during the heat treating cycle and also a well sealed condition during the time when the work is transferred from the furnace enclosure to the quench chamber.

Referring now to the drawings, there is illustrated a heat treating furnace generally designated by reference numeral **11**, which furnace is particularly adapted to heat treatment operations such as case harding, carborizing, carbonitriding and the like. The furnace includes a loading section **12**, a heated enclosure **14**, and a quench chamber **16**. The heated enclosure **14** is conventional in all respects having a refractory insulating lining and suitable gas or electric heating means (not shown). The enclosure **14** is formed with an entrance opening **20** through which work is inserted into the enclosure and a discharge opening **22** through which work is unloaded from the furnace.

A vertically movable or slidable door **24** is provided to close the entrance opening **20**. For the purpose of operating the entrance door **24** there is provided an air cylinder **26** having a reciprocating piston **28** which is connected to the lower edge of the door **24**. The entrance door **24** is formed with a thick insulating portion **24*a*** which is a suitable size to close the entrance opening **20** in the furnace enclosure. At the lower edge of the door **24** and beneath the thick insulated portion **24*a***, there is provided a flange **24*b*** which is of reduced thickness. Extending through the flange **24*b*** are two openings **24*c***. Connected to the flange **24*b*** and aligned with the outer ends of openings **24*c*** are funnel-like members **24*d***.

In normal operation, the door **24** is positioned in any one of three different positions. In the opened position, not shown in the drawings, the door is moved upwardly until the lower flange **24*b*** is above the upper edge of the entrance opening **20**. This permits the insertion of the maximum size parts as will be accommodated by the opening **20**. In FIG. 3 the door **24** is shown in its lowered position in which the thick insulated portion **24*a*** is completely covering the opening **20**. The door **24** is located in this position throughout the heat treating cycle so as to obtain maximum insulation and sealing. In FIGS. 1 and 2 the door **24** is shown in its intermediate position, the purpose of which will be explained in greater detail below.

The loading section **12** includes a frame **12***a* which supports a horizontally extending roller conveyor **12***b*. Trays of parts, or the parts themselves, may be placed on the conveyor **12***b* and slid through the entrance opening **20** into the heated enclosure **14**.

The frame **12***a* also serves to support the work transfer mechanism **30** which includes a motor and gear reduction unit **32**. The output of the motor and gear reduction unit **32** is connected by means of a chain or link belt **34** to a drive sprocket **36**. The drive sprocket **36** is mounted on a transversely extending shaft **38** which is supported by suitable bearings or pillow blocks on the frame **12***a*. Positioned inwardly of the bearings for the shaft **38** are belt sprockets **40** which drivingly engage a pair of horizontally extending flexible carrier members which may take the form of chain belts **42** and **44**. The ends of the chain belts **42** and **44** remote from the drive sprocket **36** are supported by a second transverse shaft **46** and suitably mounted sprockets **48** and **50**. It should be understood, therefore, that the motor and gear reduction unit **32** is connected to drive the chain belts **42** and **44**.

Extending horizontally above each of the chain belts **42** and **44** are push rods or work transfer rods **52** and **54**, respectively. The outer ends of the rods **52** and **54** are formed with flattened portions **52***a* and **54***a*, respectively, which may serve to engage limit switches controlling the forward and backward movement of the rods. The flatted end portions **52***a* and **54***a* are connected by means of links **56** to the respective chain belts **42** and **44**. As may best be seen in FIG. 1 the links **56** straddle the end portions **52***a* and **54***a* and employ a transversely extending pin **56***a* to pivotally interconnect the links with the rods **52** and **54**. The lower ends of the links **56** are suitably secured to the chain belts **42** and **44**. The links **56** drivingly interconnect the belts **42** and **44** with the work transfer arms **52** and **54** so that as the belts are set in motion the work transfer arms move horizontally into or out of the furnace enclosure **14**. The motor and gear reduction unit **32** is reversible so that the chain belts **42** and **44** may be moved in either direction.

It should be noted that the work transfer rods **52** and **54** as well as their driving belts **42** and **44** extend parallel to and along side the roller conveyor **12***b*. The rods **52** and **54** cannot be above the level of the roller conveyor **12***b* during the time when work is being loaded into the furnace **14**. When the rods **52** and **54** are operative to move material through the furnace, they are raised above the level of the conveyor **12***b* in the manner to be described below.

Referring to FIG. 2, the arrangement of the heated enclosure **14** and the quench chamber **16** is shown. The quench chamber **16** has a quench tank **16***a* positioned at the bottom thereof and an elevator mechanism **16***b* by means of which the parts may be lowered into the quench liquid located in the quench tank **16***a*. An opening **16***c* is formed in the quench chamber **16** in alignment with the discharge opening **22** in the enclosure **14**. To seal the exit or discharge opening **22** from the enclosure **14**, there is provided a discharge opening door **58** which is located between the enclosure opening **22** and the quench chamber opening **16***c*. The door **58** is operated by means of a suitable cylinder **59**. There is also an opening **16***d* through which parts may be removed from the quench chamber. A door **60** is mounted for slidable movement by means of a cylinder **61** to seal the discharge opening **16***d* from the quench chamber.

In considering the operation of the heat treating furnace **11**, it should be understood that the sequence of operations may be performed manually, or as is more conventional, by appropriate cycle timers and limit switches. inasmuch as the sequential automatic control of the various parts of the furnace does not form any part of the specific invention, the control circuits and mechanisms have not been disclosed therein. At the beginning of the heat treating cycle, the entrance door cylinder **26** is operated to raise the entrance door **24** to permit insertion of a tray of parts into the heated enclosure **14**. The tray of parts is shown in dotted form in FIGS. 1 and 2 and designated by reference numeral **62**. The parts tray **62** may be of any suitable size so that it may be received in the furnace enclosure **14**. It must be wider than the spacing of the work transfer rods **52** and **54** so that both of the rods may engage the end of the tray and move it through the furnace. After the tray **62** has been placed within the enclosure **14**, the door **24** is lowered to the position shown in FIG. 3 wherein the thick insulated portion **24***a* completely closes the entrance opening **20** of the heated enclosure **14**. It should be noted that in the door position shown in FIG. 3, the openings **24***c* through the flange **24***b* are positioned out of alignment with the opening **20** and therefore are not in communication with the interior of the heated enclosure **14**. To further seal the openings **24***c*, there may be provided asbestos webbing fastened at the lower edge of the insulated portion **24***a* and draped across the funnels **24***d*.

As was mentioned above, the work transfer rods **52** and **54** in their retracted position as shown in FIG. 3 are below the level of the roller conveyor **12***b*, thus permitting the conveyor to support the parts tray **62** for movement into the furnace. As may best be seen in FIG. 3, the links **56** which interconnect the belts **42** and **44** with the work transfer rods **52** and **54** respectively are inclined rearwardly at an angle of approximately 45 degrees. This inclination is caused by the fact that the links have moved around the ends of the belt sprockets **40**. This positioning of the links **56** results in the outer ends of the work transfer rods **52** and **54** being lowered below the level of the roller conveyor **12***b*. For the work transfer rods **52** and **54** to be effective in moving the parts tray **62** through the furnace enclosure **14**, it is necessary that they be raised to a level above that shown in FIG. 3 whereby their ends engage the tray **62**. This raising of the work transfer rods **52** and **54** is accomplished in part by the links **56** moving to a vertical position thereby lifting the rear ends of the rods. The forward ends are raised by virtue of their engagement with the funnels **24***d* having ramp-like lower edges, as may be seen in FIG. 2.

At the end of the heat treatment cycle, the air cylinder **26** is actuated to move the door **24** to the position shown in FIGS. 1 and 2, at which position the funnels **24***d* and the openings **24***c* are located in substantial axial alignment with the push rods or work transfer arms **52** and **54**. At the same time the door **24** is moved to the position shown in FIG. 2, the door **58** is moved to an elevated position by cylinder **59** to permit removal of the parts from the heated enclosure **14**. The motor and gear reduction unit **32** is then energized to rotate the drive sprocket **36** in a clockwise direction as viewed in FIGS. 1 through 3. The work transfer arms **52** and **54** then move from the position shown in FIG. 3 through the openings **24***c* in the door **24** in a manner shown in FIG. 2. In comparing the relative positions of the work transfer rod **54** and the roller conveyor **12***b* as shown in FIGS. 2 and 3, it may be noted that the rod **54** is raised from its position supported by the belt **44** to a position several inches higher as it moves forward as shown in FIG. 2. As was mentioned above, the link **56** has moved from an inclined to a vertical position and the front end of the rod has been biased upwardly by the funnel **24***d* as it enters the opening **24***c*. The two work transfer arms then engage the tray **62** pushing it horizontally through the discharge opening **22** in the heated enclosure **14** and into the quench chamber **16** to a position on the elevator mechanism **16***b*.

The elevator mechanism **16***b* may then be actuated lowering the parts in the tray **62** into the quench tank **16***a*. It may be appreciated that with the door **24** moved to the position shown in FIG. 2 and the quench chamber **16** sealed by the exit door **60**, the parts contained in the basket **62** are maintained in the furnace atmosphere while they are moved from the enclosure **14** into the quench

tank 16*a*. Applicant's transfer mechanism provides a simple means of transferring the parts in a sealed enclosure while at the same time utilizing a mechanism which is located completely outside of the heated area of the furnace.

While there has been shown and described a particular embodiment of the invention, it will be obvious to those skilled in the art that changes and modifications may be made without departing from the invention, and that it is intended by the appended claims to cover all such changes and modifications as fall within the true spirit and scope of the invention.

What is claimed as new and desired to be secured by Letters Patent of the United States is:

1. Heat treating apparatus comprising an enclosure having an entrance opening therein, a door slidably movable between an open position and a closed position sealing said opening, said door having a lower flange portion through which at least one hole extends, said hole being closed by the wall of said enclosure when said door is in the closed position, said door being movable into an intermediate position in which it covers said entrance opening and in which said hole is in alignment with said entrance opening, a work transfer mechanism located completely outside of said enclosure and positioned adjacent said entrance opening and including a work engaging portion in operative alignment with said entrance opening insertable through said hole and said opening when they are aligned with said door in said intermediate position of said furnace.

2. Heat treating apparatus as set forth in claim 1 wherein said work engaging portions are mounted for reciprocating movement, and funnel means are connected to said flange to guide said work engaging portion into said hole.

3. A heat treating furnace comprising a sealed enclosure having an opening through which material to be heated may be introduced into the enclosure; a slidably mounted door for said opening movable between an open position, a closed position sealing said opening, and an intermediate position; said door having at least one opening formed therein which opening is aligned with the enclosure opening when said door is in said intermediate position and sealed by a fixed wall portion of said furnace when said door is in closed position; and transfer means mounted outside of said enclosure opening in operative alignment therewith and including means insertable through the opening in said door when in the intermediate position to move said material while maintaining said enclosure sealed.

4. Heat treating apparatus comprising a sealed heated enclosure having a work entrance opening and a work discharge opening, independently operable entrance opening and work discharge opening doors movable between open nonobstructing positions and closed positions sealing said openings, a quench chamber in communication with said discharge opening, a reciprocating work advancing means mounted completely outside of said work entrance opening, said work advancing means including an elongated member insertable through said entrance opening to move work from said enclosure into said chamber through said discharge opening, said entrance opening door having at least one door opening through which said elongated member may be inserted, said door opening being sealed by a fixed portion of said furnace when said entrance opening door is in the closed position, said entrance opening door being movable to an intermediate position in which said door opening is aligned with said entrance opening and said work advancing means.

5. Heat treating apparatus comprising a furnace enclosure having a work entrance opening, a roller conveyor aligned with said opening for supporting material being moved into said furnace enclosure, a pair of spaced driven elongated flexible carrier members extending parallel to said conveyor on either side thereof, reversible drive means for said members, material transfer rods connected at their outer ends to said members for movement therewith, said rods being movable between a retracted position adjacent said roller conveyor and an operative position extending through said opening into said furnace, said rods in the retracted position being below the level at which said material is supported on said roller conveyor, said members moving the outer ends of said rods upwardly to positions above said level upon movement from said retracted positions a door for said opening having apertures therein horizontally aligned with said members and positioned above said level, means adjacent said apertures biasing said rods upwardly above said level upon movement into said apertures for engagement with material within said furnace enclosure.

6. Heat treating apparatus as set forth in claim 5 having vertically extending links interconnecting the outer ends of said rods to their respective carrier members, said links being inclined only in the retracted position of said rods to lower said rods below said level and moving to a vertical position to support said rods above said level when said rods are advanced into said furnace.

7. Heat treating apparatus as set forth in claim 5 wherein said apertures are sealed by a fixed portion of said furnace when said door is in the closed position, said door being movable to an intermediate position in which it completely covers said entrance opening and said apertures communicate with the interior of said furnace through said entrance opening, said rods being insertable into said apertures when said door is in said intermediate position.

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