

Dec. 26, 1967

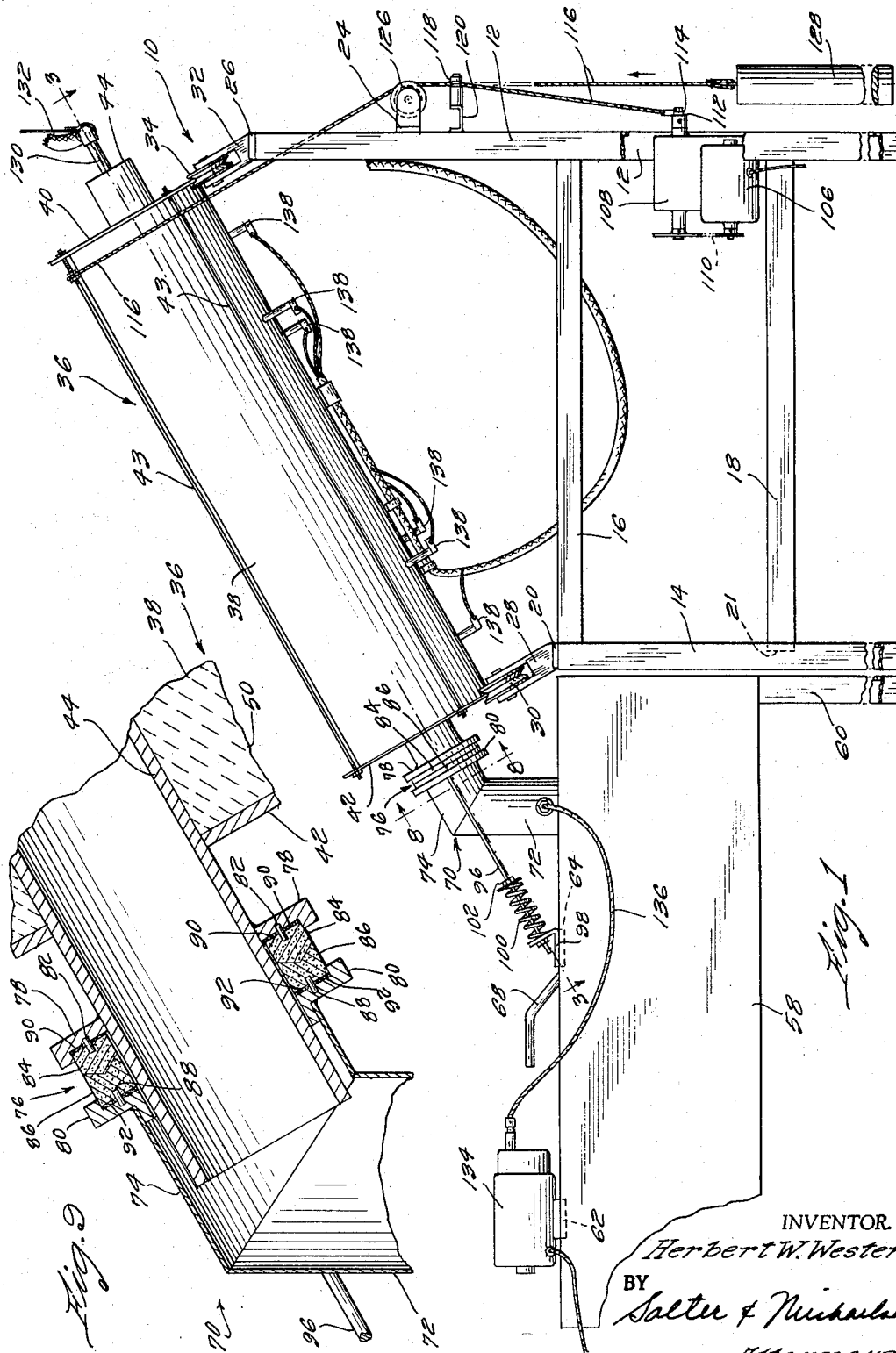
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FURNACE CONSTRUCTION HAVING STEP-BY-STEP GRAVITATIONAL FEED

Filed Oct. 13, 1965

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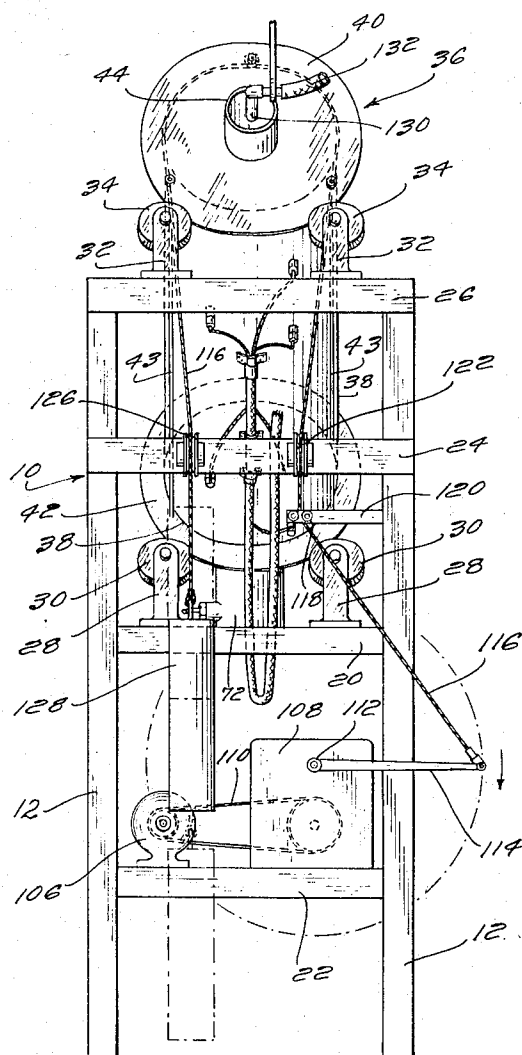


Fig. 2

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Dec. 26, 1967

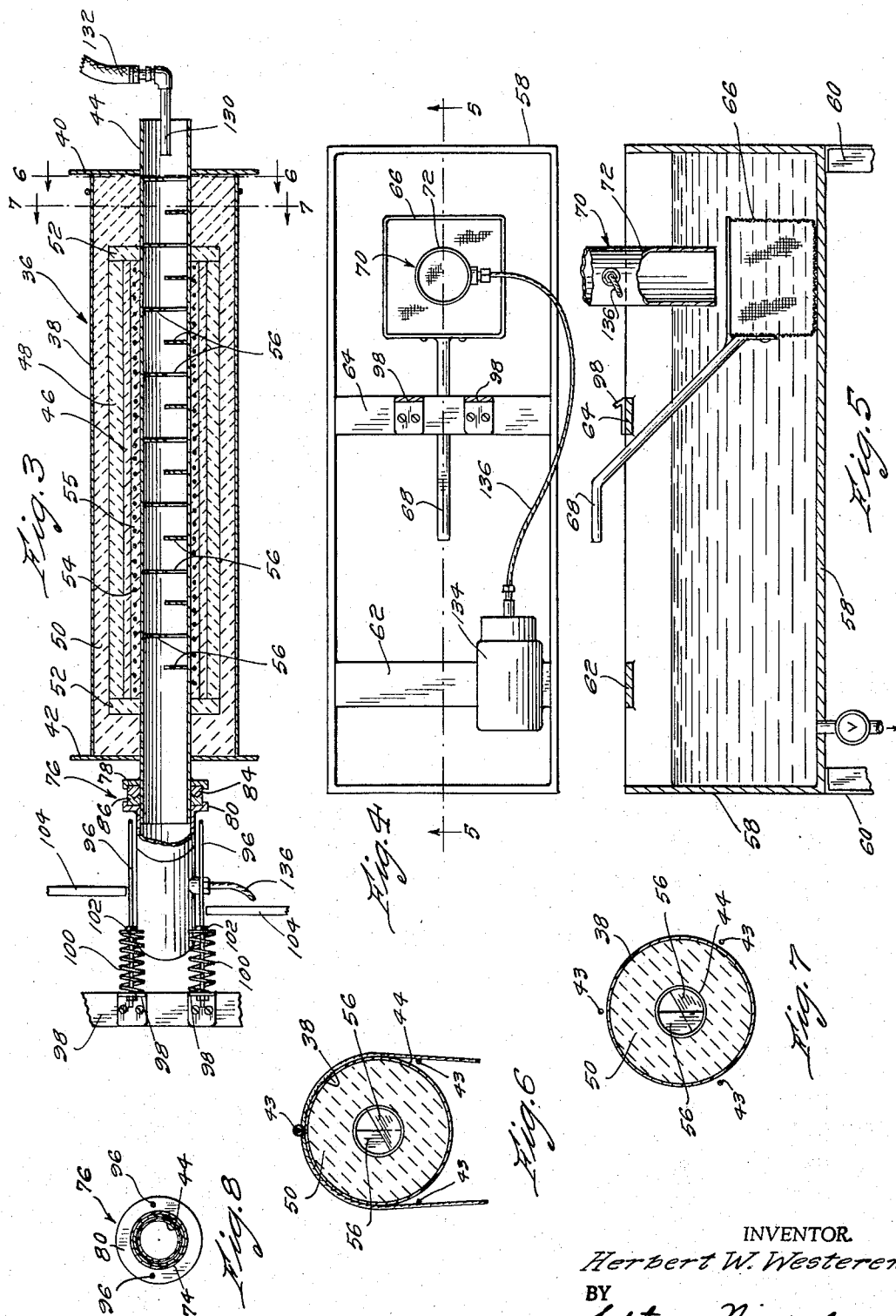
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Filed Oct. 13, 1965

3 Sheets-Sheet 3



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FURNACE CONSTRUCTION HAVING STEP-BY-STEP GRAVITATIONAL FEED

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Filed Oct. 13, 1965, Ser. No. 495,661

11 Claims. (Cl. 266-4)

ABSTRACT OF THE DISCLOSURE

A furnace construction having an inclined retort with spaced baffles extending thereacross, each of said baffles only partially blocking said retort, and unblocked part of each baffle defining a passage, the location of adjacent passages being staggered with respect to each other, whereby when rotary movement is imparted to said retort, the articles being heat treated will gravitationally descend down the inclined retort in step-by-step relation.

In the case hardening, or carbonitriding, of small metallic articles such as steel screws and the like, it is desirable to provide for continuous movement of the articles during the heat treatment thereof. Prior to the instant invention, attempts have been made to heat treat small steel articles by the continuous feed thereof, such furnaces normally being referred to as shaker hearth and vibrating feed furnaces. Although the shaker hearth and vibrating feed furnace have been used with varying degrees of success in the heat treatment of the small metallic articles, these furnaces had inherent defects that required close attention thereto on the part of the operator, since the feed mechanisms associated therewith in many instances did not provide for continuous passage of all of the articles through the furnace. Further, these furnaces were difficult to maintain and were relatively uneconomical to operate.

The present invention is designed to avoid the attendant difficulties associated with the prior known furnaces for case hardening and carbonitriding or carborizing small metallic articles. In carrying out the concept of the present invention, the furnace embodied herein is disposed in a generally inclined position and includes a retort located therein in which a plurality of baffles are disposed in parallel, spaced relation. Each of the baffles has a generally semi-circular configuration, the diametrical edge thereof being disposed in angular relation with respect to the diametrical edge of the adjacent baffle. Thus, when the articles are introduced at the uppermost end of the retort and the retort is oscillated or rotated, the articles will move in stages through the baffled areas until they reach the bottom end of the retort, from where they are discharged into a quench tank. Since a conditioning atmosphere is introduced into the retort at the upper end thereof and the baffle areas are heated by means of embedded heating elements in close proximity thereto, the articles will be effectively heat treated as they descend through the baffled areas upon oscillation of the furnace housing and retort mounted therein.

Accordingly, it is an object of the present invention to provide a carborizing and hardening furnace that employs a step-by-step gravitational feed during the heat treatment of work pieces therein.

Another object of the invention is to provide a furnace construction having a housing disposed in an inclined position and having a retort mounted therein in which a plurality of baffles are arranged in spaced, parallel relation, the baffles defining baffled areas through which the

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articles to be heat treated are continuously advanced during the heat treatment thereof.

Still another object is to provide an oscillating feed furnace for carborizing or carbonitriding small steel articles in which the articles are maintained in separated batches and are tumbled through a plurality of baffled areas so that all of the surfaces thereof are effectively exposed for an even hardening thereof.

Still another object is to provide a furnace construction through which a conditioning atmosphere is continuously circulated and that includes a plurality of baffled areas for the positive separation of batches of articles to be heat treated, the conditioning atmosphere cooperating with the baffled areas for producing an even hardening surface on the articles.

Still another object is to provide a furnace construction in which a plurality of articles are continuously moved during the heat treatment thereof and that are dumped by gravity into a quench tank for the quick quenching thereof.

Still another object is to provide a seal assembly for effectively sealing the rotating retort and a fixed discharge chute through which the articles being heat treated are discharged.

Other objects, features and advantages of the invention will become apparent as the description thereof proceeds when considered in connection with the accompanying illustrative drawings.

In the drawings, which illustrate the best mode presently contemplated for carrying out the present invention:

FIG. 1 is a side elevational view of the furnace construction embodied in the present invention;

FIG. 2 is a front elevational view of the furnace construction illustrated in FIG. 1;

FIG. 3 is a sectional view taken along lines 3-3 in FIG. 1;

FIG. 4 is a top plan view of the quench tank on which the furnace housing is mounted, the discharge chute joined to the furnace housing being shown in section;

FIG. 5 is a sectional view taken along lines 5-5 in FIG. 4;

FIG. 6 is a sectional view taken along lines 6-6 in FIG. 3;

FIG. 7 is a sectional view taken along lines 7-7 in FIG. 3;

FIG. 8 is a sectional view taken along lines 8-8 in FIG. 1; and

FIG. 9 is a sectional view of the seal assembly that joins the discharge chute to the retort.

Referring now to the drawings and particularly to FIGS. 1 and 2, the furnace construction embodied in the present invention is generally indicated at 10 and indicated at 10 and includes a frame having spaced rear standards 12 and spaced forward standards 14. The standards 12 extend somewhat vertically above the standards 14, the purpose of which will be described hereinafter. Upper and lower longitudinal connecting members 16 and 18, interconnecting the standards 12 and 14 respectively, while cross members 20 and 21 connect the standards 12, and cross members 22, 24 and 26 connect the standards 14. Mounted on the cross member 20 and extending upwardly but inclined with respect thereto are spaced brackets 28 on which rollers 30 are rotatably mounted. Similarly, brackets 32 are mounted on the cross member 26 in inclined relation with respect thereto and carry rollers 34 in rotating relation thereon.

Mounted for rotary or oscillating movement on the frame of the furnace construction is a housing generally indicated at 36. As illustrated in FIG. 1, the housing 36 is disposed in an inclined position and includes a cylindrical shell 38 to which end plates 40 and 42 are joined by

spaced longitudinal rods 43. As seen in FIGS. 1 and 3, the end plates 40 and 42 are somewhat larger in diameter than the cylindrical shell 38 and are received by the rollers 34 and 30, respectively. The housing 36 is thus mounted for rotary or oscillating movement on the rollers 34 and 30, the purpose of this movement to be described hereinafter.

Extending through the cylindrical shell 38 and the end plates 40 and 42 in coaxial relation with respect thereto is a tube or retort 44 through which the articles to be heat treated are advanced. The retort 44 is surrounded by layers of ceramic or refractory material indicated at 46, 48 and 50. As further seen in FIG. 3, ceramic end pieces 52 are also provided and enclosed heating elements 54 that are embedded in a tubular ceramic sleeve 55. The ceramic sleeve envelopes the retort 44 between the end pieces, the heating element 54 that is embedded in the sleeve providing the required heat for heat treating the articles advancing through the retort.

One of the novel features of the present invention is the movement of the articles to be heat treated through the retort 44 in such a manner that all of the surfaces of the articles are constantly exposed for the uniform heat treatment thereof. In order to accomplish this purpose, a plurality of baffles 56 are fixed within the retort 44 in spaced parallel relation. Each of the baffles 56 comprises a substantially flat plate and is formed with substantially a semi-circular configuration, the curved marginal portion thereof conforming to the configuration of the retort 44. Each of the baffles 56 thus occupies substantially one-half the cross sectional area of the retort so as to partially block same, the unblocked portion defining a passage through which the articles may pass, as hereinafter described. As further shown in FIGS. 6 and 7, the diametrical or free edge of each of the baffles 56 is disposed at a different angular relation with respect to the diametrical edge of the adjacent baffles. The spaced baffles 56 thereby define baffled areas in which the articles to be heat treated are briefly confined and are then downwardly advanced as the housing and retort are oscillated. It is seen that the baffled areas that are defined by the baffles 56 form a plurality of heating areas or spaces in which the articles are tumbled, thereby insuring that all of the surfaces of the articles advancing through the retort are effectively heated during the heat treatment process. As will be described, the housing 36 is oscillated in one direction for 180 degrees and is then rotated counter to the first direction for return movement of 180 degrees. As the housing is continuously oscillated, the work pieces are continuously tumbled as they advance through the baffled areas, the advancing movement being promoted by the inclined position of the housing and the particular relationship of the semi-circular baffles 56.

Located adjacent to the frame of the furnace construction 10 is a quench tank that includes legs 60 and on which cross pieces 62 and 64 are mounted. Any suitable quench liquid may be located in the quench tank 58 and, as shown in FIG. 5, a basket 66 is normally positioned therein for receiving the work pieces as they are directed into the quench tank from the retort 44. A convenient handle 68 is connected to the basket 66 for the manipulation thereof.

In order to direct the workpieces from the retort 44 into the quench tank 58, a discharge chute generally indicated at 70 is provided and includes a vertical chute portion 72 to which an inclined chute portion 74 is joined and that defines an elbow therein.

Since the discharge chute 70 is fixed and the retort 44 is rotatably moved during the heat treatment operation, a seal assembly generally indicated at 76 is provided and includes a disc 78 that is fixed on the retort by welding or the like. Joined to the inclined chute portion 74 of the discharge chute 70 is a similarly constructed disc 80 that is mounted on the retort 44 in bearing relation therewith. Pinned to the plate 78 by suitable pins 82 is a

graphite bearing 84 that is formed with a tapered surface that is received in the corresponding tapered groove formed in a graphite bearing 86. The graphite bearing 86 is pinned to the plate 80 by suitable pins 88 and gaskets 90 and 92 are located between the plate 78 and bearing 84, and plate 80 and bearing 86, respectively. It is seen that the graphite bearings 84 and 86 not only define radial and thrust bearings for the rotating retort 44, but also act to concentrically locate the retort 44 during movement thereof. Further, since the graphite bearings effectively resist the high temperatures in the retort, a seal is maintained therebetween. The seal acts to prevent the conditioning gas that is introduced into the retort from escaping therefrom, and further prevents atmosphere from seeping into the retort at the lower end thereof and contaminating the work pieces passing therethrough. Thus, oxidation or decarborization of the work pieces is effectively prevented. The tapered portion of the bearing 84 and the corresponding groove formed in the bearing 86 insure that the bearings are maintained in alignment and thus act to retain the retort 44 in proper concentric position.

In order to maintain the graphite bearing members 84 and 86 in effective sealing relation, rods 96 are provided one end of which are received in grooves formed in the outer surface of the disc 80. The other ends of the rods 96 are fixed to upstanding brackets 98 that are mounted on the cross piece 64 of the quench tank. Tension springs 100 are mounted between the brackets 98 and collars 102 fixed on the rods 98 and act to force the rods 96 in a direction toward the bearing members 84 and 86. The disc 80 is thus effectively forced into positive engagement with the gasket 92, and the bearing members 84 and 86 are thereby retained in positive bearing relation. As seen in FIG. 8, the rods 96 are located slightly above the center of the disc 80. This location of the rods 96 acts to equalize the pressure at the seal on both the top and bottom portions thereof. It is also contemplated to employ guide bars 104, as indicated in FIG. 3, for restricting lateral movement of the discharge chute but permitting some limited movement thereof. These guide bars 104 will be connected to the quench tank 58 in any suitable manner.

Referring again to FIGS. 1 and 2, the drive for rotatably moving the housing 36 is illustrated and includes a motor 106 that is mounted on the cross member 22 and that is drivably connected to a speed reducer 108 through a belt 110. Extending outwardly from the speed reducer is an output shaft 112 to which a drive arm 114 is secured. Joined to the outermost end of the drive arm 114 is a cable 116 that extends upwardly toward the housing 36, being guided thereto by guide rolls 118 mounted on a bracket 120 fixed to the standard 12 and by a guide pulley 122 that is mounted on the cross member 24. The cable 116 extends around the uppermost end of the housing 36 and is secured to the topmost longitudinally extending rod 43 that is fixed to the end flanges 40 and 42 of the furnace housing 36. The cable 116 further extends downwardly over a pulley 126 and has a counterweight 128 fixed to the end thereof. Upon rotation of the drive arm 114, the cable 116 will act to rotate the housing 36 in a clockwise direction as seen in FIG. 2, for 180 degrees and will then, upon continuous movement, rotate the housing 36 in a counterclockwise direction for 180 degrees to produce an oscillating movement. The housing 36 will thus be oscillated continuously during operation of the furnace for advancing the workpieces through the baffled areas.

The furnace construction 10 is normally employed for the hardening of carbon steel pieces or carburizing or carbonitriding low carbon steel pieces. In order to effectively heat treat the steel pieces, a treatment atmosphere is introduced into the retort at the upper end thereof by means of an inlet pipe 130 to which a conduit 132 is connected, the conduit 132 communicating

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with a source of the treatment atmosphere. Although the treatment atmosphere does not form any part of the present invention, it is understood that such an atmosphere may consist of natural gas or nitrogen in which 2-3% carbon monoxide is contained. Other treatment atmospheres that may be employed are dissociated ammonia or an endothermic atmosphere. The inlet pipe 130, which is utilized for introducing the treatment atmosphere into the retort 44, is also utilized for purging the retort upon completion of the heat treatment cycle. An inert atmosphere can thus be introduced into the retort 44 by means of the inlet pipe 130 for carrying out the purging operation.

During the operation of the furnace, it is desirable to vent or extract the treatment atmosphere from the retort 44 so that it does not enter the quench tank 58. For this purpose, an aspirator or exhaust pump 134 is mounted on the cross piece 62 of the quench tank 58 and communicates with the vertical chute portion 72 of the discharge chute 70 through a conduit 136.

As further shown in FIGS. 1 and 2, current is introduced to the heating element 54 through electrical connections 138. These electrical connections are spaced throughout the length of the retort 44 and supply the necessary current to the heating element 54 for effectively heating the retort. In connection with the controls for heating the retort, the length of the retort that is heated is divided into three control zones. The three control zones, which include a central zone and two end zones, are controlled from a master instrument for producing a uniform heat throughout the length of the heating zone in the retort. The central zone is normally controlled from the master instrument, and the end zones are arranged so as to follow the central zone. Thus, proper control is maintained for delivering the desired heat in the various zones.

In operation of the furnace construction 10, the workpieces are introduced into the retort 44 at the upper end thereof, and the treatment atmosphere is also introduced at this point. Upon operation of the motor 106 and control of the heating zones for producing the required heat within the retort 44, the workpieces are effectively heat treated as they advance downwardly through the baffled areas into the retort. Since the workpieces are briefly restrained from downward movement by the baffles 56, positive separation of batches of the workpieces is obtained; and further, because of the tumbling action due to the oscillating movement of the retort, all of the surfaces of the workpieces are sufficiently exposed for producing an even hardening thereof. As the workpieces advance toward the end of the retort 44, they are directed into the quench tank 58 by the discharge chute 70 for quick quenching thereof. This quick quenching process further acts to produce an effective hardened surface on the workpieces.

While there is shown and described herein certain specific structure embodying the invention, it will be manifest to those skilled in the art that various modifications and rearrangements of the parts may be made without departing from the spirit and scope of the underlying inventive concept and that the same is not limited to the particular forms herein shown and described except insofar as indicated by the scope of the appended claims.

I claim:

1. In a furnace construction for heat treating a plurality of workpieces, an elongated shell mounted in an inclined position, a plurality of spaced baffles in said shell, each extending substantially normal to the longitudinal axis of said shell, said baffles defining a plurality of heating areas, each of said baffles comprising a substantially flat plate having a marginal edge in contact with a portion of the periphery of said shell and having a free edge extending thereacross, whereby each baffle partially blocks said retort with the unblocked part defining a passage, the free edges of adjacent baffles being angularly disposed

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with respect to each other, thus resulting in staggering of the location of adjacent passages, means for imparting movement to said shell about its longitudinal axis to permit step-by-step gravitational advance of the workpieces down the inclined shell and through said passages from one area to the next-adjacent one, and means for heating said areas for heat treating said workpieces as they advance through said shell.

2. In a furnace construction for heat treating a plurality of workpieces, an elongated cylindrical housing mounted in an inclined position and having an inner shell in which a plurality of baffles are positioned and into the uppermost end of which said workpieces are introduced, said baffles being disposed in spaced relation in said inner shell to define a plurality of heating areas therein, each baffle having a generally semi-circular configuration so that the diametrical edge thereof is angularly disposed with respect to the diametrical edges of the baffles located adjacent thereto, wherein a circuitous heating path for said workpieces is defined in the inner shell of said housing, means imparting movement to said shell about its longitudinal axis for advancing said workpieces downwardly along said circuitous path and through said heating areas, and means for heating said heating areas for heat treating said workpieces as they advance there-through.

3. In a furnace construction for heat treating a plurality of workpieces, an elongated housing mounted in an inclined position, a retort fixed in said housing and having a plurality of baffles positioned therein, said baffles being disposed in spaced relation in said retort to define a plurality of heating areas therein each of said baffles having a generally semi-circular configuration, the diametrical edge thereof being angularly disposed with respect to the diametrical edges of the adjacent baffles so as to define a circuitous heating path in said retort, means for oscillating said housing about the longitudinal axis thereof for advancing said workpieces downwardly along said circuitous path and through said heating areas, and means for heating said heating areas for heat treating said workpieces as they advance therethrough.

4. In a furnace construction as set forth in claim 3, a quench tank located on the downstream side of said housing, a discharge chute engaging the lowermost end of said retort and located above said quench tank for guiding the heat treated articles from said retort into said quench tank, and means for urging said discharge chute into engagement with said retort for maintaining an effective seal therewith during oscillating movement of said retort with said housing.

5. In a furnace construction as set forth in claim 3, a frame on which said housing is mounted, said frame including spaced anti-friction elements, said housing having members mounted thereon that engage said anti-friction elements, wherein said housing is freely rotatable with respect to said frame, said oscillating means including an arm that is interconnected to said housing and that is rotatably driven by motor means for producing an oscillating movement of said housing.

6. In a furnace construction as set forth in claim 3, said heating areas being divided into a plurality of heating control zones including a central zone, said heating means being controlled for producing a required temperature in said central zone, the heating means in the control zones around said central zone being responsive thereto for producing the required temperature therein.

7. In a furnace construction for heat treating a plurality of workpieces, a frame, an elongated housing mounted for rotating movement on said frame and disposed thereon such that the longitudinal axis of said housing is inclined, a retort located in said housing and having a plurality of baffles positioned in parallel, spaced relation therein, each of said baffles having a generally semi-circular configuration, the diametrical edge of each baffle being located in different angular relation with respect

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to the diametrical edge of the adjacent baffles, wherein a circuitous path for said workpieces in said retort is defined, means for oscillating said housing and retort therein for periodically advancing said workpieces downwardly along the circuitous path defined by said baffles in said retort, and means for heating said retort for heat treating said workpieces as they advance through said retort.

8. In a furnace construction as set forth in claim 7, a quench tank located below the downstream side of said housing for receiving the heat treated articles therein for the quick quenching thereof, a non-rotary discharge chute engaging the downstream end of said retort for guiding said workpieces into said quench tank, and means for maintaining said non-rotary discharge chute in engaging relation with said retort during the oscillating movement thereof.

9. In a furnace construction as set forth in claim 8, said maintaining means including a bearing assembly that comprises a first bearing that is fixed to the upper end of said discharge chute and a second bearing that is fixed to the lower end of said retort, one of said bearings having a projecting tapered face and the other having a tapered groove formed therein for receiving said tapered face in bearing relation, and means for urging said bearings into bearing relation for establishing a seal between said discharge chute and retort.

10. In a furnace construction as set forth in claim 7, means for introducing a conditioning gas into said retort at the upstream end thereof, and means for exhausting

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the conditioning gas from said retort at the downstream end thereof.

11. In a furnace construction as set forth in claim 7, said frame including spaced forward standards and spaced rearward standards, said forward standards being elevated with respect to said rearward standards, rollers mounted on said standards, and flange members fixed to the forward and rearward ends of said housing and engaging said rollers, wherein said housing is mounted in inclined position for rotating movement on said rollers.

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