United States Patent [19]

Shaefer et al.

[11] **3,836,324**

[45] **Sept. 17, 1974**

[54] CONTINUOUS ROTARY HEAT TREATING FURNACE

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[73] Assignee: **American Gas Furnace Company**, Elizabeth, N.J.

[22] Filed: **Aug. 6, 1973**

[21] Appl. No.: **385,772**

[52] **U.S. Cl.** **432/112**, 432/115, 432/117

[51] **Int. Cl.** **F27b 7/08**, F27b 7/24, F27b 7/32

[58] **Field of Search** 432/103, 112, 115, 117

[56] **References Cited**

UNITED STATES PATENTS

1,820,668	8/1931	Lobley	432/112 X
3,272,489	9/1966	Heyer et al.	432/117 X
3,441,259	4/1969	Heyer et al.	432/115

Primary Examiner—John J. Camby
Attorney, Agent, or Firm—Omri M. Behr; Peter J. Gaylor

[57] **ABSTRACT**

A continuous rotary heat treating furnace including a furnace housing defining a heating chamber therein, and a cylindrical furnace retort for conveying work through the furnace, the retort being mounted for for rotation within the heating chamber. A circumferential collar is mounted in gas sealing relationship to, and extends about the periphery of the furnace rotort near the discharge end thereof. The collar extends radially beyond the circumference of the furnace housing, to preclude gaseous communication between the discharge end of the retort and the heating chamber. Roller support means underlie the furnace housing, and engage with the periphery of the collar. An axially displaceable cylindrical sub-assembly, closed at one end by a heating chamber, approximately mates with the side of the collar facing the discharge end of the retort and includes spring biased sealing means perfecting the gas seal of the heating chamber. A downwardly directed opening in the sub-assembly permits the work passing from the retort, to drop directly through the sub-assembly to an underlying quench tank or the like.

9 Claims, 5 Drawing Figures

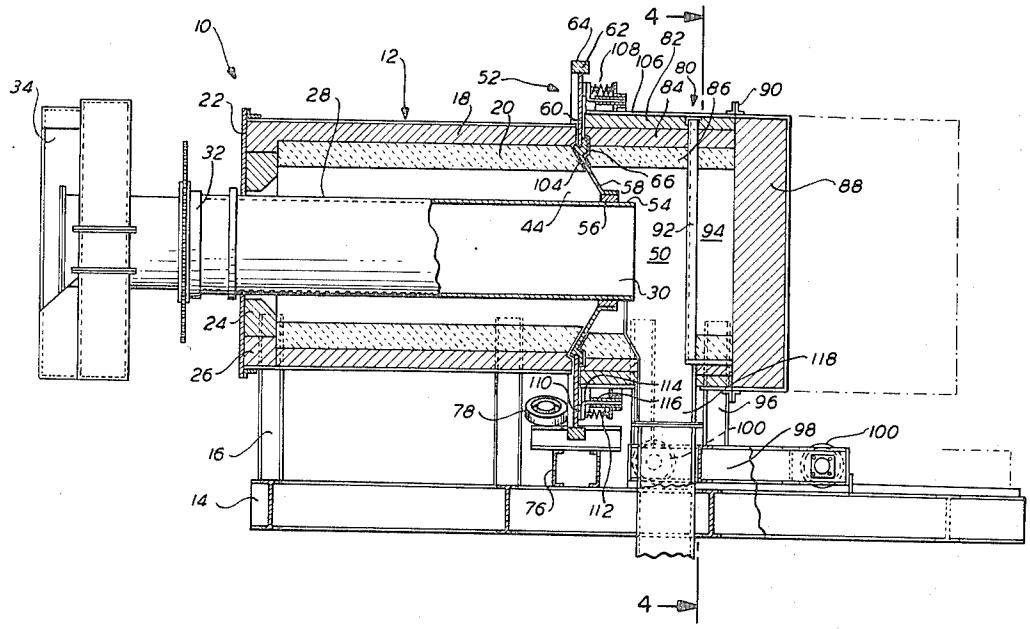


FIG. 1

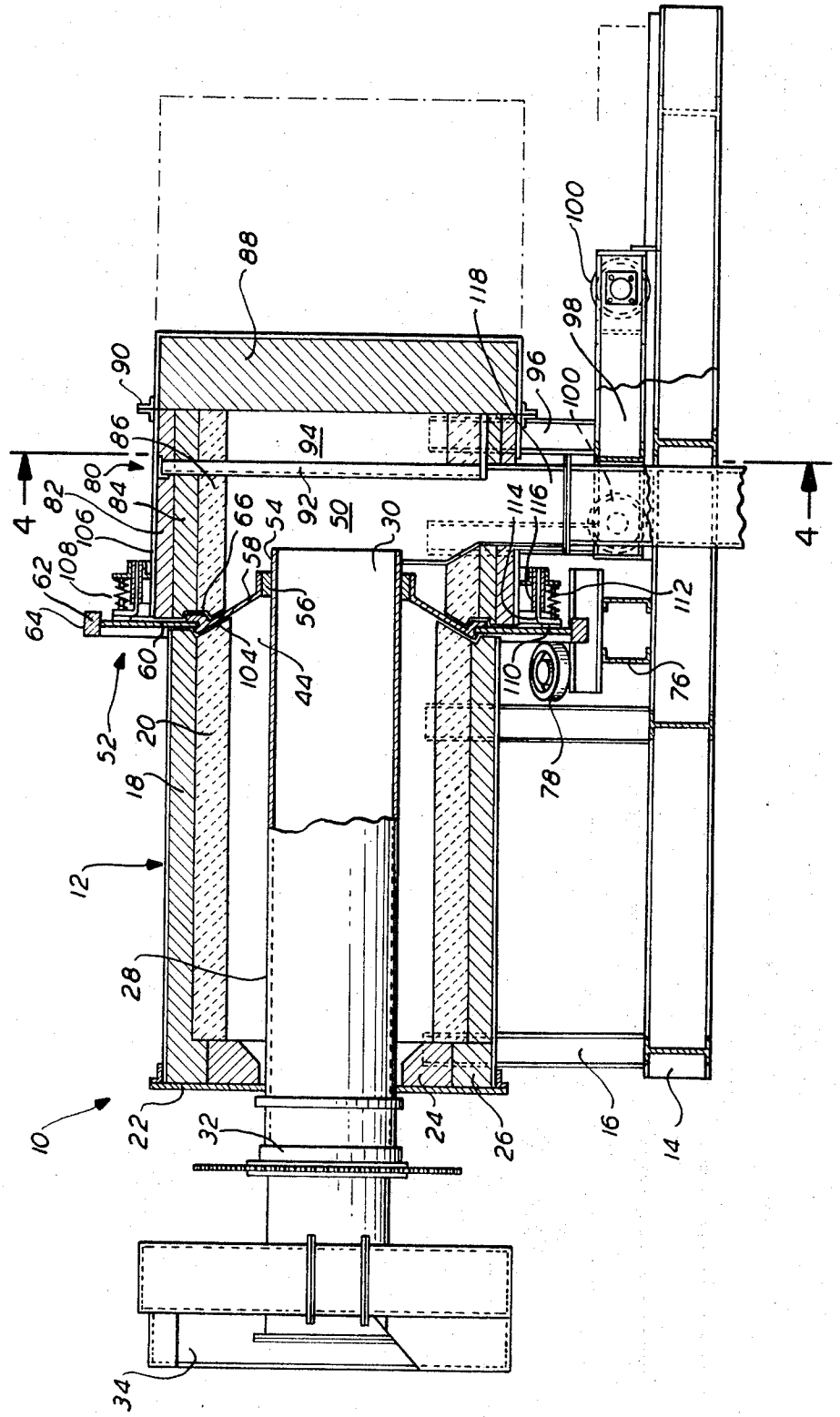

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FIG. 2

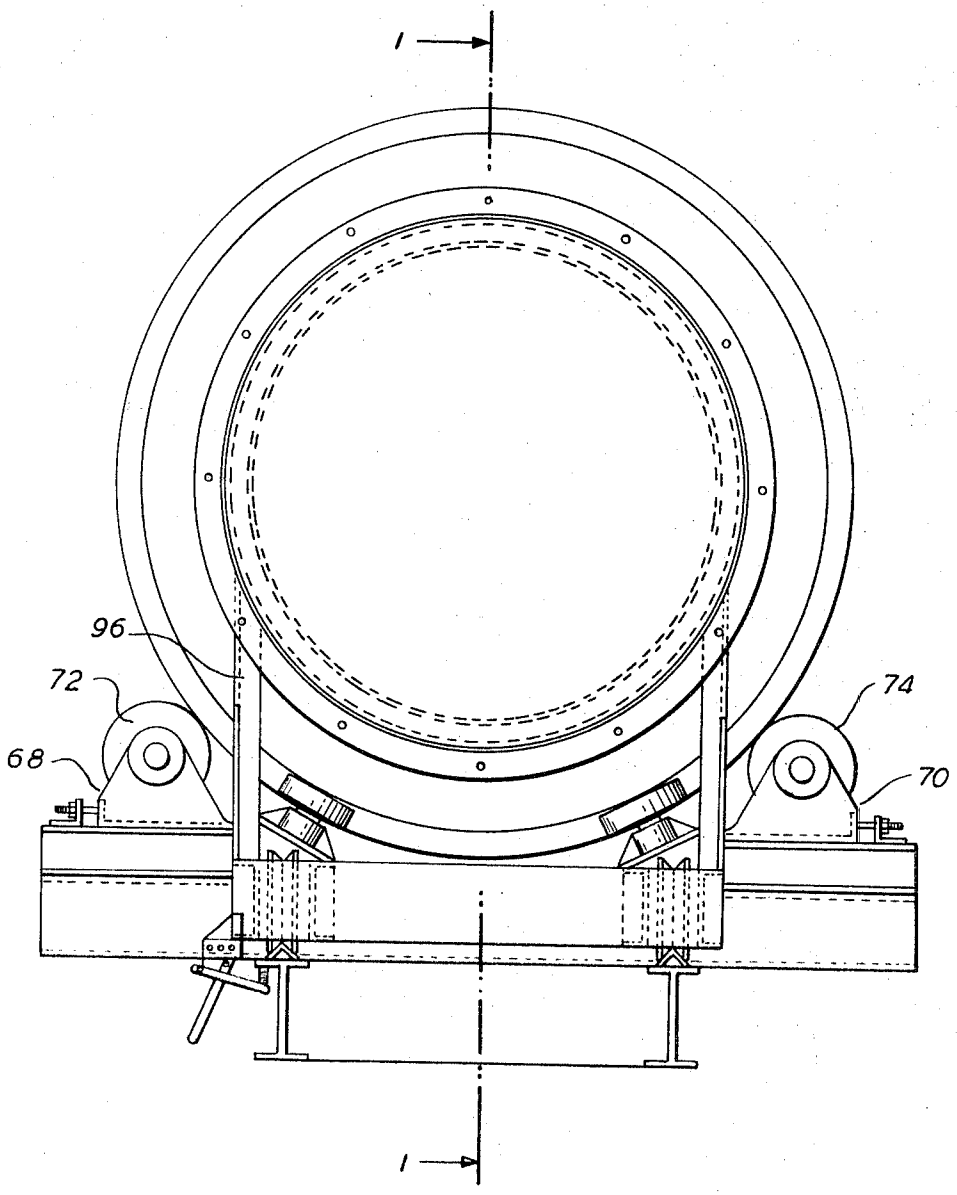


FIG. 3

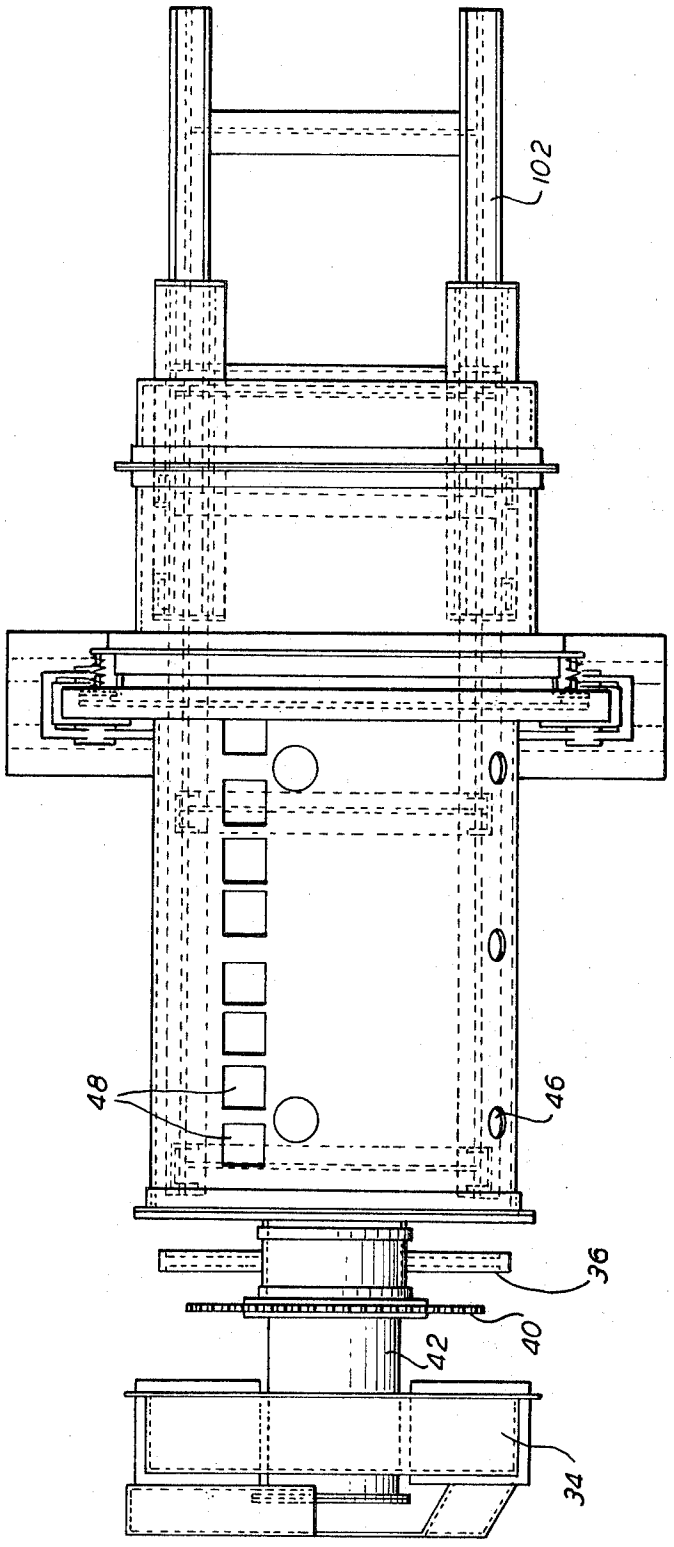


FIG. 4

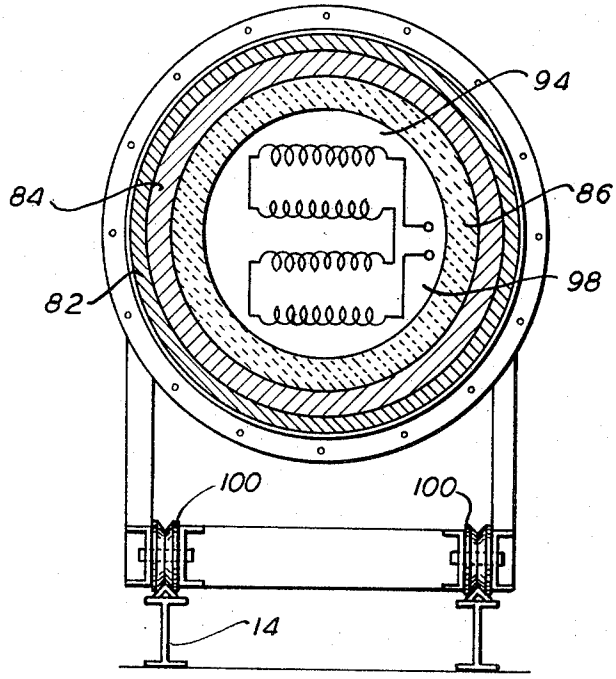
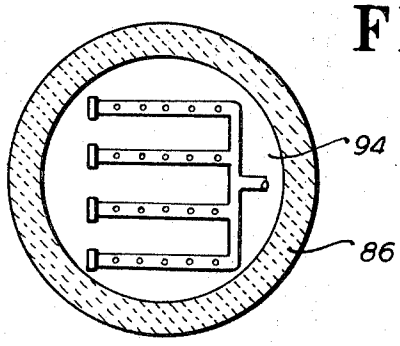


FIG. 5



CONTINUOUS ROTARY HEAT TREATING FURNACE

BACKGROUND OF INVENTION

This invention relates generally to heat treating furnaces, and more specifically relates to such furnaces as are provided with a rotatable retort through which work to be treated in the furnace is continuously passed.

Heat treating furnaces of the continuous rotary type, have been utilized for many years for the purposes of treating work pieces or the like, which are passed through the furnace retort in a continuous or semi-continuous fashion. In the usual mode of operation of furnaces of this type, a controlled gaseous atmosphere is established within the retort, as for example, by maintaining a controlled reducing atmosphere therein. Parts which are to be heat treated, as for example, small hardware such as bolts, nuts, screws, etc., are in one manner or another conveyed through the said retort as it rotates within a surrounding heating chamber. Conveying of the said parts may, for example, be effected by the use of ridges projecting inwardly from the walls of the retort and defining a continuous Archimedes spiral therein, or the axis of the retort may simply be inclined toward its work input end so that as it rotates the work pieces tend to gradually move toward the output end thereof. Furnaces of the general type discussed herein are illustrated at many points of the prior art, including, for example, in U.S. Pat. No. 3,441,259.

In a controlled atmosphere heat treating furnace of the type considered herein, heating of the furnace chamber within which the retort rotates, is commonly effected by introducing hot gases from burners positioned about the furnace housing; or electrical heating coils may similarly be mounted within said heating chamber. In the past, a problem has tended to arise by virtue of the fact that the controlled gaseous atmosphere present within the retort (and also adjacent the discharge end thereof), has tended to leak from such points into the heating chamber. Where such undesirable condition obtains, seriously deleterious effects can occur. Among other things, for example, the performance or life of the heating elements in the case of electric elements, may be impaired; similarly, the gaseous matter from the retort and adjacent points can upon entering the heating chamber enter into combustion with other gases therein, not only causing damage and general impairment of the condition of the said chamber, but moreover introducing uncontrolled temperatures into the furnace with resulting detrimental effect upon the parts being treated. In the past, various constructions have been proposed in an effort to overcome the gas leakage problems discussed above. Thus, for example, in Heyer, U.S. Pat. No. 3,441,259, above mentioned, an apron is provided about the retort at the discharge end thereof, which in some respects alleviates the cited problem. The said apron, however, utilizes a pair of sealing rings engaging the end wall of the furnace housing, which is not basically a sound point to preclude the phenomena occurring.

Upon the treated parts exiting from the retorts of furnaces of the type considered herein, they are commonly moved or permitted to fall to a quench tank. In order for this process to be conducted with maximum

efficacy, it is necessary that the parts be maintained at the desired control temperature throughout the period that they progress to the quench tank, including (as appropriate) the period of fall toward the said tank. By and large, however, prior art constructions have simply been inadequate to secure the said purpose. In, for example, the Heyer patent, above referenced, the apron referred to is specifically intended to serve as a discharge guide for conveying the parts being treated to a chute, in turn descending to a quench tank. In an effort to maintain temperatures in the discharge path including the chute at an appropriate desired point, a conical insulated plug closes the heat treating furnace and partially defines the discharge chute. In this instance, as in many prior art constructions, however, the descending parts must necessarily pass through unheated zones, and indeed in the construction actually set forth necessarily contact the discharge apron.

In accordance with the foregoing, it may be regarded as an object of the present invention, to provide a continuous rotary heat treating furnace, enabling completely gas-tight separation between the discharge end of the retort and adjacent discharge zone of the furnace chamber, and the heating chamber of the furnace.

It is a further object of the present invention, to provide a continuous rotary heat treating furnace, wherein gas communication between the work discharge zone of the furnace and the furnace heating chamber, is precluded; and wherein further the furnace is so constructed that parts discharging from the retort may descend in unimpeded fashion to underlying receiving points, such as to quench tanks; and wherein further a controlled temperature environment is positively established within the said discharge zone, thereby assuring that the falling work pieces are maintained at their desired temperature as they proceed toward quench.

SUMMARY OF INVENTION

Now in accordance with the present invention, the foregoing objects and others as will become apparent in the course of the ensuing specification, are achieved in a continuous rotary heat treating furnace, including a furnace housing which serves to define a heating chamber therein, and a cylindrical furnace retort mounted for rotation within the heating chamber. The interior of the retort may be provided with a conventional Archimedes spiral, or the axis thereof may be inclined to enable conveyance of the work pieces during rotation of the retort. A circumferential collar is mounted in gas sealing relationship with and extending about the periphery of the retort near the discharge end thereof. The collar extends radially beyond the furnace housing, to preclude gaseous communication between the discharge end of the retort and the heating chamber. Roller support means underlie the furnace housing and engage with the periphery of the collar. An axially displaceable sub-assembly, closed by a heating chamber, approximately mates with the side of the collar facing the discharge end of the retort, with a spring biased sealing ring being mounted about the periphery of the subassembly to perfect a more positive seal. A downwardly directed opening in the sub-assembly permits the work passing from the retort to drop directly through the sub-assembly, to an underlying quench tank or other receiving point.

BRIEF DESCRIPTION OF DRAWINGS

The invention is diagrammatically illustrated by way of example in the drawings appended hereto, in which:

FIG. 1 is a longitudinal cross-sectional view taken along the line 1—1 of FIG. 2 herein, of a rotary heat treating furnace in accordance with the present invention;

FIG. 2 is an end view of the FIG. 1 apparatus; and

FIG. 3 is a top plan view of the said apparatus.

FIG. 4 is a cross-sectional elevational view taken along line 44 of FIG. 1 hereof showing that portion of the supplemental heating assembly behind the heating shield wherein the heating means is electrical.

FIG. 5 shows a partial embodiment of the view of FIG. 4 wherein the heating means is gas fired rather than electrical.

DESCRIPTION OF PREFERRED EMBODIMENT

In FIGS. 1, 2 and 3 herein, cross-sectional, end, and plan views, respectively appear, of a rotary heat treating furnace 10 in accordance with the present invention. The furnace 10, as best seen from the cross-sectional view of FIG. 1 (taken along the line 1—1 of FIG. 2), includes a furnace housing generally designated at 12, which is supported from a base 14 by legs 16. The housing 12 is defined by an outer wall 18, an inner cylinder lining 20 of insulating refractory material or the like, and a closing plate 22 — spaced from wall 18 and cylinder 20 by a pair of rings 24 and 26. An annular opening within plate 22 enables passage of the cylindrical heating retort 28. The said retort is essentially a tube, formed of metal or cast of alloy or the like, which is open at the output end 30 thereof, and joined at its input end 32, to a spiral retort work feeder which is generally indicated at 34. The latter is a conventional device, not per se part of the present invention, and serves to feed work to input end 32 of retort 28. Retort 28 is mounted for rotation within housing 12, as is known in the art, and may be rotatably driven by a chain drive which engages sprocket 40 at the portion 28 extending outside of plate 22. The externally extending portion of retort 28 is supported for rotation on a pair of support wheels 36. Work feeder 24, portion 42, sprocket 40, and retort 28 are all bolted together and rotate as a unit.

The retort 28, as is known in the art, may include inwardly directed ridges defining an Archimedes spiral, so that as the retort undergoes rotation, work pieces provided from feeder 34 may continuously progress toward the output end 30 of the retort. Similarly, as is also known in the art, the geometry of furnace 10 may simply be such as to render output end 30 at a gravitationally lower point than the input end of the retort, so that the parts undergoing treatment tend to progress during retort rotation by means of the gravitational forces acting thereon.

Within lining 20 of furnace housing 12, there is defined a heating chamber 44. In the embodiment illustrated, such chamber is cylindrical, but other geometries such as rectangular can be utilized. Gas emitting ports may be provided through the walls of housing 12, so as to inject hot gases within the heating chamber 44; or alternatively, as is known in the art, electrical heating coils may be present within the chamber 44, for similar purposes. None of these heating arrangements are per se of the present invention. In order, however, to concretely illustrate the invention and render apparent the advantages yielded thereby, it may be assumed that hot gases are thus provided to chamber 44 to establish the required high temperature therein. Openings 46 for the gas nozzles are thus indicated in FIG. 3, with exhaust flue openings being shown at 48. As has been previously discussed, a serious problem is now presented, in that under typical operating conditions a desired gaseous atmosphere (e.g. a reducing atmosphere, an oxidizing atmosphere, etc.) is established within the interior of retort 28, either by feeding the desired gas from the input end 30 of the retort or alternatively by establishing such an atmosphere via feeding at the discharge zone 50 immediately adjacent output end 30. Under such conditions prior art constructions have been such as to render possible leakage of the provided gases about the wall adjacent the discharge end of the retort, and backward along such wall into the heating chamber 44. Under such conditions adverse effects may result — e.g. if a reducing atmosphere is utilized such gases can enter into combustion with the gases already present in the said chamber 44; similarly, where electrical heating coils are present in chamber 44, reaction with the materials thereof can occur, rendering the coils ineffective, or at least impaired in performance.

In accordance with one aspect of the present invention the foregoing difficulty is eliminated by means of the annular collar generally indicated at 52. As is seen best in FIG. 1 the said collar 52 is secured in a gas sealing relationship at the forward, reduced portion 54 of retort 28, the collar rotating with retort 28 during furnace operation. Specifically, a spacer 56 is secured about portion 54 by welding or the like, and an angled portion 58 is welded or otherwise joined to spacer 56 and to a flat, ring-like portion 60. A flange 62 is permanently secured, as by welding, or bolting, to portion 60, to define the outermost portion of collar 52. It is seen that the outermost flat edge 64 of flange 62, thus extends, radially, considerably beyond the outside diameter of housing 12. By virtue of the backwardly directed angularity of portion 58, heat expansion of collar 52 may occur during operation of furnace 10, without severe distortion of the furnace geometry.

Positioned at an axial point approximately beneath the discharge end 30 of retort 28, is a pair of roller support means, indicated generally at 68 and 70 (FIG. 2). Roller support means 68 and 70 include rollers 72 and 74, which as has already been indicated, engage with the flat face 64 of flange 62, to enable virtually frictionless rotary motion of retort 28. The roller support means 68 and 70, which are secured to base 14 of the furnace by support members 76, are seen to also carry thrust rollers 78, which may engage the adjacent faces of collar 52 to constrain the rotating retort against horizontal motion.

The elements thus far described of furnace 10, preferably coact during operation of the furnace with a sub-assembly, generally designated at 80. Sub-assembly 80 in the present instance is provided with cylindrical geometry complementary to housing 12, but can be of rectangular or other geometry to assure mating with the said housing where the latter element is of corresponding geometry. The sub-assembly 80 is seen to be defined by a pair of outer concentric cylinders 82 and 84, and a concentric inner insulating liner 86, preferably of refractory material similar to liner 20 of housing

12. Sub-assembly 80 is closed at one end by a cap 88, which is joined to the remainder of the subassembly through a flange 90. A relatively thin plate 92 extends across the interior of assembly 80 at an axial point spaced from cap 88, so as to define a heating chamber 94, into which hot gases may be fed, by means not shown. Electrical heating elements or other heating means can also be utilized for providing heat at a surface adjacent space 50, and depending on the nature of such heating means the hollow chamber 94 may or may not be required. Sub-assembly 80 is supported by legs 96 from an underlying carriage 98. The carriage includes rollers 100 which engage with an underlying track support, indicated generally at 102. The said construction thereby enables sub-assembly 80 to be axially displaced toward and away from the remainder of furnace 10.

Sub-assembly 80 is further seen to be open at one end thereof, in particular at the end facing the remaining elements of furnace 10. Additionally, it is seen that the face 104 of lining 86, has a configuration as to permit the said face to approximately mate against the adjacent surface of angled portion 58 of collar 52, when the sub-assembly is moved against housing 12 and the said collar. Further, however, it is seen that the external wall 106 of cylinder 84 carries a sealing means, indicated generally at 108. This sealing means is characterized by including a sealing ring 110 of graphite or the like, which is biased against the adjacent face of portion 60 of collar 52 by springs 112, or other means, e.g. hydraulic or pneumatically actuated pistons or so forth. The said springs are compressed as sub-assembly 80 is brought into proximity to collar 52, and bear against the displaceable member 114 which is mounted for such movement in slide support piece 116.

The operation of the present furnace when fully assembled with sub-assembly 80 may be readily comprehended. In particular it will be seen that when subassembly 80 is positioned against the remainder of the furnace 10, the vertically oriented opening 118 provided at the bottom of said sub-assembly, is directly beneath discharge end 30 of retort 28. Here it should be appreciated that the configuration of the present device, including the position of opening 118, is such that a completely free, unimpeded fall path is provided directly beneath the discharge zone 50 adjacent the end 30 of the retort. Accordingly, as the work pieces pass from the discharge end 30 of the retort, they may freely descend through opening 118 to an underlying quench tank or the like, without in any way contacting, or in other manner being impeded. At the same time, the heating chamber 94 provided directly in proximity to discharge zone 50, readily radiates heat through the thin plate 92, to provide an accurately controlled temperature environment within discharge zone 50. Accordingly, this combination of circumstances assures that as the work pieces descend through the said zone, the temperature of the said pieces is accurately maintained until they impinge at the quenching media. At the same time, the collar 52 in cooperation with the sealing means that have heretofore been discussed, assure that heating chamber 44 is completely sealed against gases entering same, either from the retort proper or from discharge zone 50.

While the present invention has been particularly set forth in terms of specific embodiments thereof, it will be understood in view of the instant disclosure that numerous variations upon the invention are now enabled on those skilled in the art, which variations yet reside within the scope of the present teaching. Accordingly the invention is to be broadly construed and limited only by the scope and spirit of the claims now appended hereto.

We claim:

1. A continuous rotary heat treating furnace, comprising in combination:

a furnace housing defining a heating chamber therein;

a cylindrical furnace retort mounted for rotation within said heating chamber, said retort having a work input and a work discharge end;

roller support means underlying said furnace housing near the discharge end of said retort;

a circumferential collar mounted in gas sealing relationship with and extending about the periphery of said retort at an axial position near the discharge end thereof, said discharge end protruding beyond all axial points of said collar, said collar having a portion extending radially beyond the circumference of said housing, and engaging said underlying support means;

a discharge chute, the upper end of said chute being located proximate to and directly beneath the discharge end of the retort, whereby the work discharged from said retort is permitted to fall unimpededly through said chute;

gas sealing means at least partially sealing with said collar portion to preclude gaseous communication between the discharge end of said retort and said heating chamber;

means for loading work at said input end of said retort and conveying said work through said retort for discharge at the discharge end thereof; and

means for rotating said retort, together with said roller-supported collar.

2. Apparatus in accordance with claim 1, further including a sub-assembly having a heated portion closing one end thereof, and open at the opposite end thereof, said sub-assembly being mounted for axial displacement toward and away from the discharge end of said retort and furnace housing, the walls of said sub-assembly being adapted to approximately mate with the side of said collar toward said discharge end of said retort; said sub-assembly including an unobstructed downwardly directed opening beneath the discharge end of said retort when said sub-assembly is engaged with said collar, permitting said work to drop in unimpeded fashion through said sub-assembly and discharge opening to an underlying receiving point.

3. Apparatus in accordance with claim 2, wherein said sub-assembly carries said gas sealing means.

4. Apparatus in accordance with claim 3, wherein said gas sealing means comprises biased sealing rings mounted at the periphery of said sub-assembly, adapted for sealing engagement with the opposing face of said collar when said sub-assembly is axially positioned adjacent said retort and furnace.

5. Apparatus in accordance with claim 4, wherein said sub-assembly is track-mounted for said axial movement.

6. Apparatus in accordance with claim 4, wherein said heating chamber is gas heated.

7. Apparatus in accordance with claim 4, wherein said cylindrical heating chamber is electrically heated.

8. Apparatus in accordance with claim 4, wherein said roller means includes at least a pair of rollers mounted on axes parallel to the axis of said retort and chamber, said rollers engaging said collar at a flange formed about the periphery of said collar.

9. Apparatus in accordance with claim 8, wherein said roller means further includes thrust rollers, rotatable on axes radially directed with respect to said retort and furnace, said thrust rollers engaging the lateral faces of said collar.

* * * * *

UNITED STATES PATENT OFFICE
CERTIFICATE OF CORRECTION

Patent No. 3,836,324 Dated September 17, 1974

Inventor(s) Frederick C. Schaefer, Frank Korzeb, William I. Bayly

It is certified that error appears in the above-identified patent and that said Letters Patent are hereby corrected as shown below:

The correct spelling of the inventors name is "Schaefer" and not Shaefer.

In the abstract, line 4, delete the word for-second occurence.

In the abstract, line 7, correct the spelling of the word "retort".

Column 3, line 13, change line 44 to --line 4-4--

Column 3, line 45, change "24" to --34--.

Signed and Sealed this

twenty-eight Day of *October 1975*

[SEAL]

Attest:

RUTH C. MASON
Attesting Officer

C. MARSHALL DANN
Commissioner of Patents and Trademarks