April 6, 1965 W. H. HOLCROFT 3,176,970

ROTARY RETORT FURNANCE FOR HEAT TREATING PARTS IN CONTROLLED ATMOSPHERE

Filed July 17, 1961 2 Sheets-Sheet 1

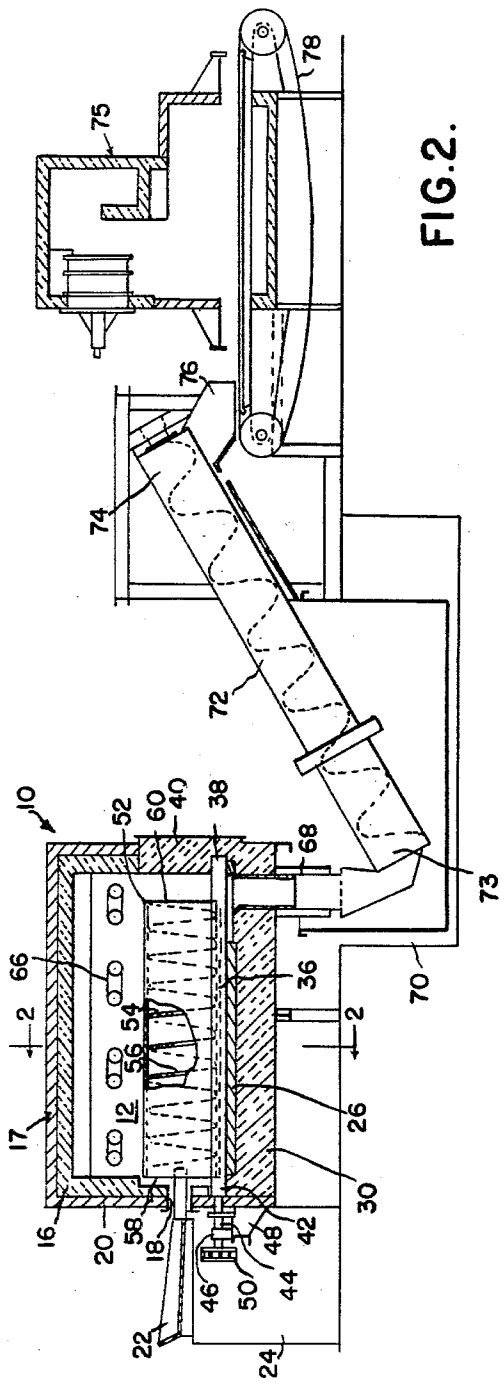


FIG. 1.

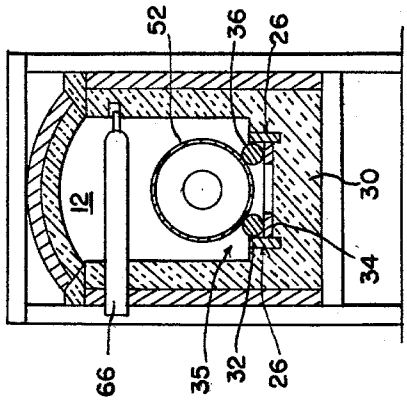


FIG. 2.

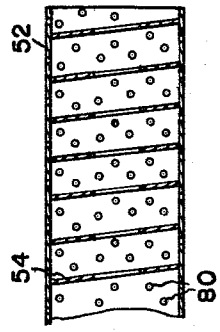


FIG. 3.

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ROTARY RETORT FURNANCE FOR HEAT TREATING PARTS IN CONTROLLED ATMOSPHERE

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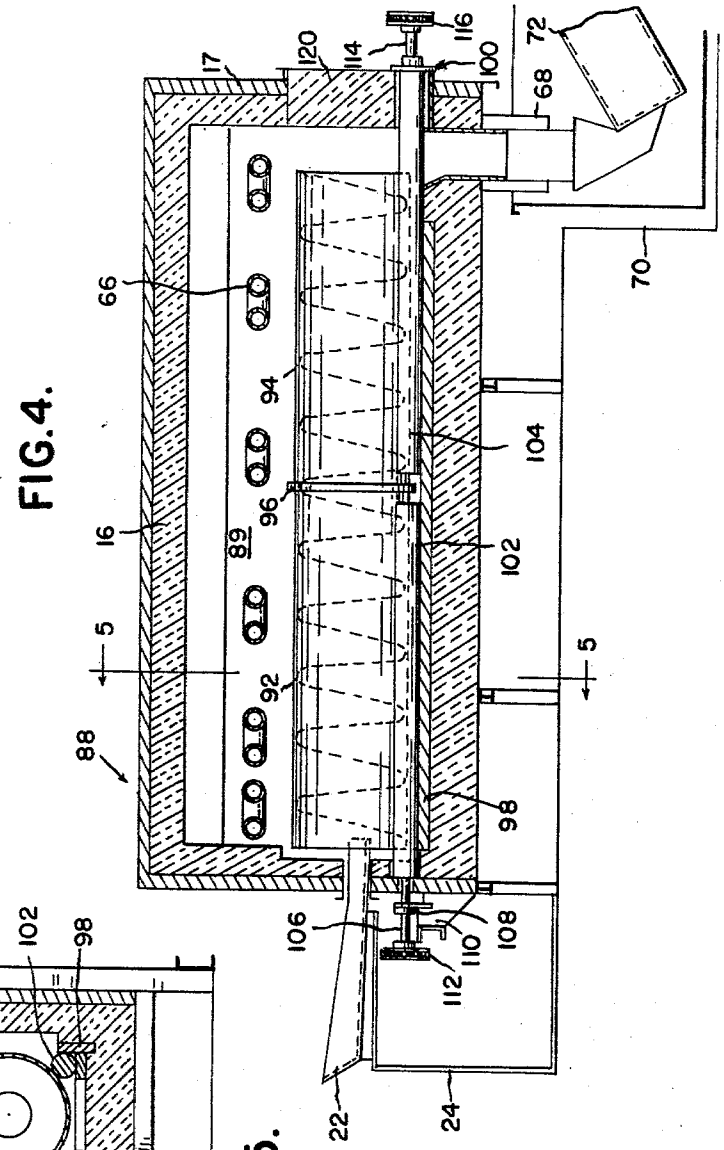


FIG. 4.

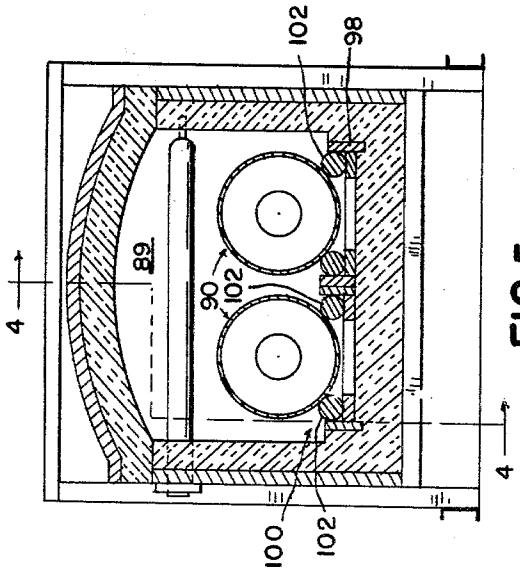


FIG. 5.

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ROTARY RETORT FURNACE FOR HEAT TREATING PARTS IN CONTROLLED ATMOSPHERE

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6 Claims. (Cl. 266—4)

This invention relates to a heat treating furnace of the rotary retort type and relates more particularly to the circulation of a controlled gaseous atmosphere through small articles or parts to be heat treated that are located in the rotary retort of the furnace. Use of a controlled atmosphere to envelop the work in process enables the heat treater to closely control the surface appearance as well as the chemical and physical properties of the work.

Heat treating apparatuses of the type described for carburizing small articles or parts have been utilized in the art with some difficulty. Generally, a tubular retort having a helical passageway therein transports the small articles through the furnace in large quantities while exposing the parts to the controlled atmosphere in a random or non-uniform manner, with the result that some of the articles have greater case depths than others. In the past, the standard retort was mounted as a structural member in the furnace and utilized stub shafts at one end which extended through the end wall of the furnace chamber and which was supported therein by roller bearings mounted exteriorly of the furnace chamber. With such a construction, the rotating retort spanned the entire length of the furnace. This required that the retort, in order to have sufficient strength, be made with heavy walls and internal screw sections, thereby increasing the required temperature differential between the outside and inside of the retort so that the requisite amount of heat be transmitted from the chamber into the interior of the retort. Inasmuch as the retort extends through the back end wall of the furnace for driving purposes, the work is discharged through radial openings provided in the cylindrical wall of the retort. The prior art retort of the type just described is made of a costly metal alloy which requires an expensive casting technique.

It is an object of the present invention to provide a heat treating furnace which is provided with a rotary retort mounted entirely within the furnace and having its entrance and discharge openings located in the ends of the retort.

Another object of the present invention is to provide a heat treating furnace which has a rotating roller support extending longitudinally through the furnace and a rotary retort supported by the roller support and entirely dependent thereon for its rotation.

Still another object of the present invention is to provide a heat treating furnace which has beams extending longitudinally of the furnace chamber, a power driven roller support supported by the channel beams, and a rotary retort supported and driven in rotation by the roller support.

A further object of the present invention is to provide a heat treating furnace which eliminates the use of the rotary retort as a structural member therein and the requirement that the retort be made by an expensive casting technique. As a result, the retort is made of a relatively light or thin wall welded construction, thereby saving in construction costs and also lessening the resistance to the inward passing of heat.

Another object of the present invention is to provide a heat treating apparatus of the aforementioned type which is simple in construction, easy to maintain and economical to manufacture.

Other objects and features of the invention will become apparent as the description proceeds, especially

when taken in conjunction with the accompanying drawings, illustrating preferred embodiments of the invention, wherein:

FIGURE 1 is an elevational view, partly in section, illustrating a typical furnace arrangement designed to handle relatively small parts and including a carburizing furnace, quench tank and draw furnace.

FIGURE 2 is a sectional view taken on line 2—2 of FIGURE 1 and illustrating the relationship between the pair of driven rollers and rotary retort utilized in the carburizing furnace.

FIGURE 3 is a fragmentary view in section showing a modified form of the rotary retort.

FIGURE 4 is an another embodiment of the present invention illustrating a carburizing furnace having a pair of longitudinally aligned rotary retorts.

FIGURE 5 is a sectional view taken on line 5—5 of FIGURE 4.

Referring now to the drawings, the carburizing or heat treating furnace which forms the essential part of the present invention is designated by the numeral 10 and is mounted above the floor as is shown in FIGURE 1. The walls of the heat treating furnace 10 define a heating chamber 12 and are formed of a high heat resistant refractory material 16 such as insulating firebrick, mono block insulation or other suitable material. The refractory material 16 is enclosed in a substantially gas-type metal casing 17.

The heat treating unit 10 has an entrance section 18 in the front end wall 20 thereof and has a feed chute 22 mounted on a support 24 adjacent the front end wall 20. A pair of longitudinally extending beams 26, as best illustreated in FIGURE 2, is supported by the bottom wall 30 and adjacent side walls of the furnace 10. Each channel beam or member 26 includes a vertical member 32 and a horizontal member 34 which are arranged so as to provide a channel beam having a substantially T-shaped cross section. The channel beams are made from silicon carbide. This material, when subjected to extreme temperatures, exhibits the required rigidity and strength and also presents a very hard wearing surface. A roller support 35, including a pair of longitudinally extending rollers 36 made from steel or some other suitable refractory material, is mounted lengthwise of the furnace 10 and is substantially supported by the channel beams 26. The front ends 42 of the rollers 36 are provided with stub shafts 44 which extend through the front wall 20 of the furnace 10. Each shaft 44 is mounted on a bearing 46 carried by a support 48 located exteriorly of the furnace 10. Appropriate power driven drive means including the sprocket 50 are provided for driving the rollers 36 in timed relationship.

A retort 52 is located entirely within the chamber 12 and is supported by the roller support 35, which includes the rollers 36, and driven in rotation thereby. The retort 52 is made from an appropriate alloy which is rolled into the desired cylindrical configuration. The retort 52 is provided with internal screw sections 54 which are made from an appropriate alloy and which are secured to the walls of the retort housing by welding. The retort of the type described in the prior art utilized a cast alloy material. The walls of the retort were solid and approximately ¾" thick. The retort of the present invention is made of an appropriate alloy and has a wall thickness of approximately ¼" to ⅜". This substantial reduction in wall thickness is due to the fact that the retort 52 of the present invention is not arranged in the furnace 10 as a structural member.

The retort 52 provides therethrough a helical passageway 56. The entrance to the retort 52 is provided in the front end wall of the retort 52 and is designated by the numeral 58. The exit or discharge for the retort 52 is

provided in the back end wall thereof and is designated by the numeral 60. It is sufficient to say at this time that small articles or parts are directed from the feed chute 22 into the helical passageway 56 of the retort 52. The parts, upon rotation of the retort 52 by the roller support 35, are advanced through the helical passageway 56 to the discharge end 60.

The chamber 12 is heated by means of a plurality of radiant U tubes or burners 66 supported transversely within the chamber 12. FIGURE 1 shows that four burners are utilized. However, it should be understood that the number of burners may be varied to suit different requirements. The burners 66 per se are identical in construction and form no part of the present invention. Gas and air are introduced separately into each of the tubes 66 and are progressively mixed by a controlled diffusion after they pass through the tubes 66, thus providing an ideal luminous flame. The heating medium may be gas or oil. The tubes 66 are heated by the flame and in turn radiate heat to the surrounding furnace walls and to the retort 52. The controlled gas atmosphere, which may be one of a number of suitable types, such as a gas with a high methane content, is directed into one or both ends of the chamber 12 by a suitable piping arrangement, not illustrated, which is well known in the art.

A suitable motor driven fan, not shown, may be provided in the chamber 12 for circulating the furnace atmosphere around the burners as well as through the helical passageway 56 so as to thoroughly direct the atmosphere around and through the articles being processed in the retort 52.

The discharge end 60 of the retort 52 is spaced from the end wall 40 of the furnace so that the articles may be discharged into the space therebetween. A discharge chute 68 is connected through an opening located in the bottom wall 30 of the furnace 10 immediately below the space between the discharge end 60 of the retort 52 and the end wall 40 of the furnace 10. The discharge chute 68 is directed into a quench tank 70 generally located below the normal level of the floor. The tank 70 may be filled with water, oil, or another suitable quenching medium. A rotary tubular conveyor 72 which includes a helical passageway has the entrance end 73 connected to the discharge chute 68 and the exit end 74 adjacent the entrance to a draw furnace represented by the numeral 75. The exit end 74 of the conveyor 72 is provided with a chute 76 which is mounted directly above a continuous belt-type conveyor 78 which moves the articles discharged thereon through the draw furnace 75 where the final processing of the articles takes place so as to remove certain stresses which may have been induced into the articles by the previous heat treating operations and to insure that the finished articles have the requisite properties.

When oil is utilized in the quench tank 70, a wash stand, not shown, is generally provided between the tubular conveyor 72 and the draw furnace 75 so as to remove the oil film from the articles prior to the final processing thereof in the draw furnace 75.

In operation, the articles enter the retort 52 through the chute 22. The roller support 35 including the pair of rollers 36 is rotated according to a predetermined pattern so as to rotate the drum first in one direction and then in the other direction with a net forward rotation, as an example, a revolution gain every half hour. This pattern of rotation subjects the parts in the retort 52 to the requisite tumbling action. With such a construction, the gas atmosphere is directed into the retort 52 generally from both ends thereof and is fully circulated around and through the articles so as to obtain the maximum possible exposure and the requisite uniformity in case depth. With such a tumbling action, the articles are permitted to dribble out the discharge end 60 into the quench tank 70. The dribbling action generally provides a better quench for the articles than obtained with the prior art constructions.

FIGURE 3 shows a modification of the retort 52 wherein the circumferential wall of the retort is provided with a plurality of relatively small holes 80, which may be of varying size, so as to permit the gas atmosphere to enter the interior of the retort 52 through the cylindrical wall of retort 52 as well as through the end walls of the retort 52.

Another embodiment of the present invention is illustrated in FIGURES 4 and 5. Where applicable, the same numerical designations will be utilized. Theoretically, with the present invention any number of retorts of varying diameters and lengths may be utilized. The second embodiment differs from the first embodiment illustrated in FIGURE 1 in the arrangement of the retort and the rotary support therefor. A pair of longitudinally extending retorts 90 extending lengthwise of the furnace 88 is provided. Each retort 90 is made of two sections 92 and 94 of equal lengths which have their adjacent ends appropriately flanged or fastened together as is indicated at 96 in FIGURE 4. Two pairs of channel beams 98 made from silicon carbide extend longitudinally through the chamber 89, one pair for each of the rotary retorts 90. Supported by the channel beams 98 are the roller supports 100. Each of the roller supports 100 consists of a pair of transversely spaced rollers 102 located in the forward half of the furnace 88 and a pair of transversely spaced rollers 104 located in the back half of the furnace 88. The rollers 102 and 104 are longitudinally arranged lengthwise of the furnace and are carried substantially by the channel beams 98 as is illustrated in FIGURE 4.

The rollers 102 have stub shafts 106 which extend through the front wall of the furnace 88 and are mounted in bearings 108 carried by a support 110. The outer ends of the stub shafts 106 are provided with sprockets 112 which are adapted to be driven by appropriate drive means. The rollers 104 have stub shafts 114 which extend through the back end wall of the furnace 88 and have mounted thereon sprockets 116 which are adapted to be driven by a power drive arrangement. The sprockets 112 and 116 are driven in timed relationship so as to rotate the roller support 100 and effect rotation of the retort 90.

The discharge ends of the retorts 90 are spaced from the end wall 120 of the furnace 88 so as to permit the articles to be discharged into the space therebetween from where they fall into the discharge chute 68 and are subsequently transported from the quench tank 70 through the rotary tubular conveyor 72 in the manner described for the embodiment illustrated in FIGURE 1.

The drawings and the foregoing specification constitute a description of the improved furnace in such full, clear, concise and exact terms as to enable any person skilled in the art to practice the invention, the scope of which is indicated by the appended claims.

What I claim as my invention is:

1. A heat treating apparatus comprising a walled chamber heated to an elevated temperature for containing a controlled gas atmosphere, a rotary open-ended retort mounted lengthwise of and completely within said chamber and forming a helical passageway extending axially thereof, and into one end thereof small articles of work are fed which under rotation are advanced therethrough to be discharged at the opposite end, and a rotating support in said chamber for supporting the entire length of said retort for driving said retort in rotation, said rotating support having rolling supporting contact with the outer cylindrical surface of said rotary retort for substantially the entire length thereof.

2. A heat treating apparatus comprising a walled chamber heated to an elevated temperature for containing a controlled gas atmosphere, said chamber having opposite end walls, a rotary open-ended retort mounted lengthwise of and completely within said chamber between said end walls and forming a helical passageway extending axially thereof, said retort being an open-ended metallic cylinder, a loading chute extending through the front wall of said chamber into one end of said retort for delivering small

articles into the helical passageway of said retort, a discharge chute in the bottom wall of said chamber below an open end of said cylinder, and a rotating support extending lengthwise in said chamber for supporting the entire length of said retort for rotating said retort, thereby advancing the articles therethrough where they are discharged from the other end of the retort into said discharge chute, said rotating support having rolling supporting contact with the outer cylindrical surface of said rotary retort for substantially the entire length thereof.

3. A heat treating apparatus comprising a walled chamber heated to an elevated temperature for containing a controlled gas atmosphere, said chamber having opposite end walls, a rotary open-ended retort mounted lengthwise of and completely within said chamber between said end walls and forming a helical passageway extending axially thereof, and into one end thereof small articles of work are fed which under rotation are advanced therethrough to be discharged at the opposite end, and a rotating support in said chamber for said retort for driving said retort in rotation, said rotating support including a pair of transversely spaced longitudinally extending rolls for rotatably supporting the entire length of said retort, said rotating rolls each having rolling supporting contact with the outer cylindrical surface of said rotary retort for substantially the entire length thereof.

4. In a furnace for heat treating parts in a controlled atmosphere, the combination of a substantially gas tight heating chamber having enclosing walls including opposite end walls defining the lengthwise extent of said chamber, a metallic cylindrical retort of length less than the distance between said end walls and having its opposite ends within said heating chamber, said retort having a helical passageway, rollers beneath said cylindrical retort for rotatably supporting the same along the entire length thereof and channel beams within said heating chamber for rotatably supporting said rollers, said rollers having rolling supporting contact with the outer cylindrical surface of said retort for substantially the entire length thereof.

5. In a furnace, the combination as defined in claim 4 in which said cylindrical retort is open at opposite ends thereof, a loading chute extending through the front wall of said heating chamber through an open end of said cylindrical retort, means outside said heating chamber for rotating said rollers to thereby cause rotation of said cylindrical retort and the advancement of said parts through said helical passageway, and a discharge chute through the bottom wall of said chamber below the open exit end of said cylindrical retort.

6. In a furnace for heat treating parts in a controlled atmosphere, the combination of a substantially gas tight heating chamber having enclosing walls including opposite end walls defining the lengthwise extent of said chamber, a metallic cylindrical retort of length less than the distance between said end walls and having its opposite ends within said heating chamber, rollers beneath said cylindrical retort for rotatably supporting the same, said rollers having rolling supporting contact for substantially the entire length of said cylindrical retort, means outside said heating chamber for rotating said rollers to thereby cause rotation of said cylindrical retort, said retort being provided with internal sections for engaging the parts within the retort to thereby obtain a tumbling action during rotation, and a discharge chute from said chamber extending downwardly into a quench tank below said heating chamber.

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