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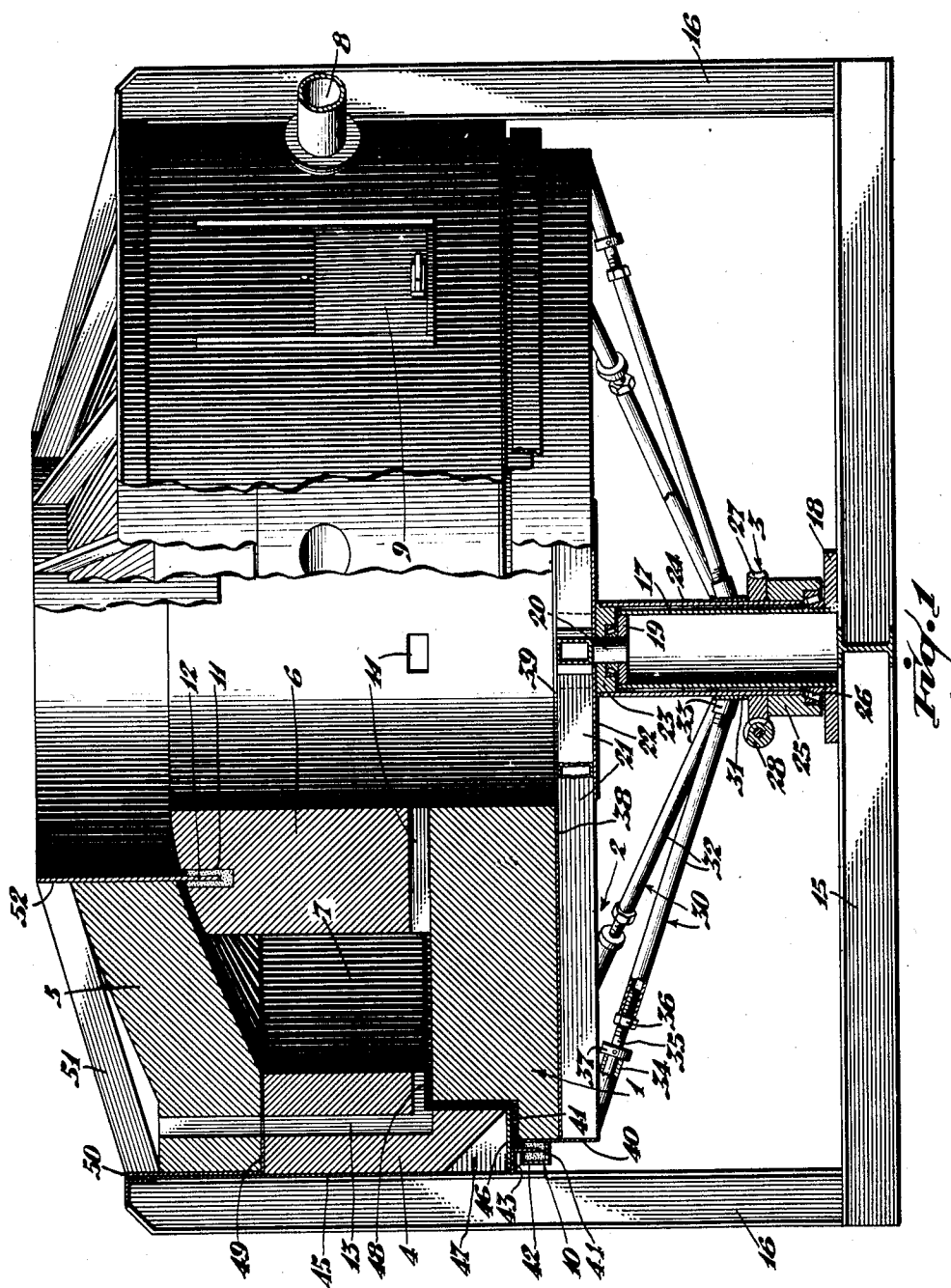
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2,334,050

ROTARY FURNACE

Filed Aug. 4, 1942

2 Sheets-Sheet 1



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2 Sheets-Sheet 2

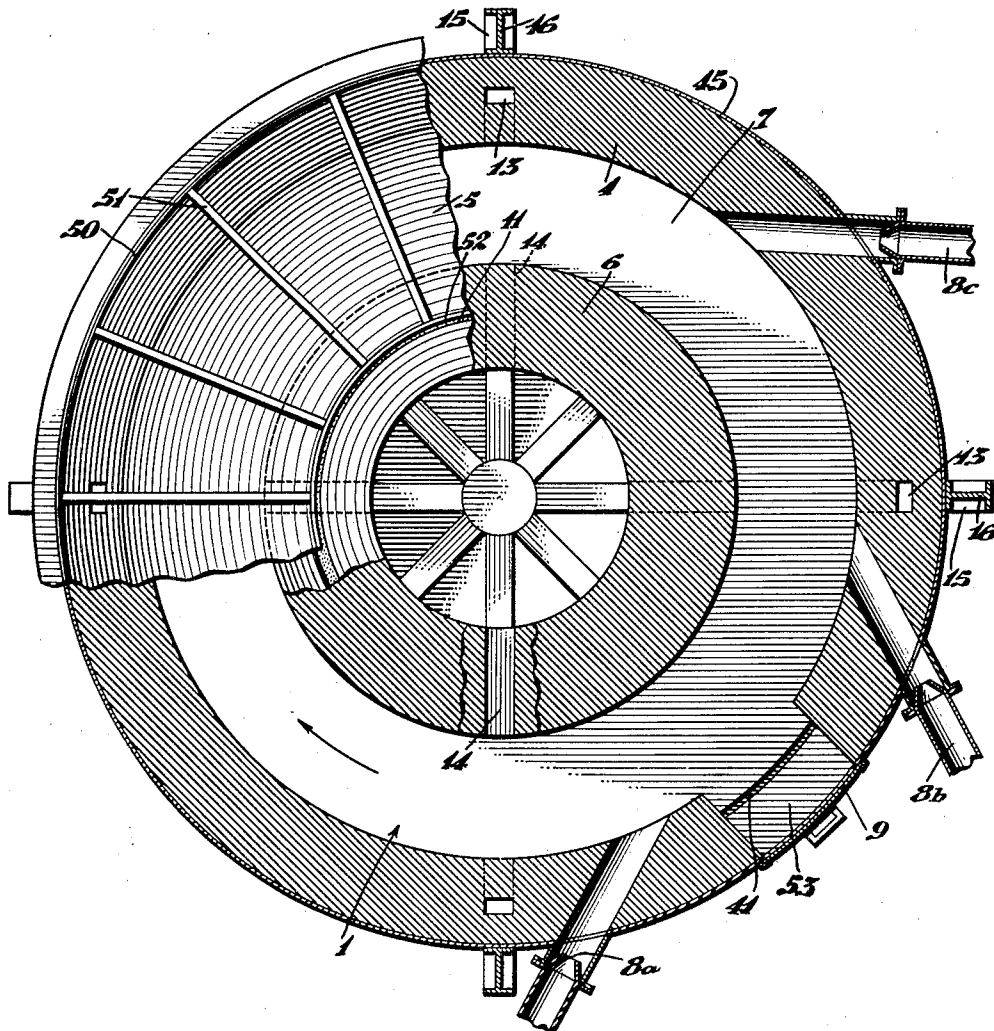


Fig. 2

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UNITED STATES PATENT OFFICE

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ROTARY FURNACE

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8 Claims. (Cl. 263—35)

This invention relates to an improved rotary type heat treatment furnace. The furnace is of the continuously operating type, pieces to be treated being placed into the furnace at one point upon a rotating hearth, carried by the hearth through an annular heated chamber, and removed from the furnace at a point adjacent the charging door.

While furnaces of this general type have been known and used in the past, the primary objective of the present invention has been to simplify the construction and make the units less expensive to build. Inasmuch as special unusual precautions are required to enable the hearth to be rotated mechanically and yet withstand high temperatures, the cost of the furnaces heretofore available has been such that they have not enjoyed the widespread usage otherwise expected of them. In this respect the present invention is addressed particularly to a structure in which the hot gases provided from suitable burners are confined effectively to an annular chamber through which the hearth rotates and permitted to escape only through suitably constructed vents and not elsewhere. In this manner the gases are prevented from causing disintegration of the metal parts and rotary drive members of the hearth.

A further objective of the present invention, however, has been to provide means for obtaining progressive heating action of metal parts placed on the hearth without employing the multiplicity of burners utilized in prior designs. In this respect the invention is characterized by the use of a limited number of burners, for example, two or three, located in spaced relationship throughout a limited sector or portion of an annular relatively small heat chamber of the furnace periphery, and not uniformly throughout the furnace periphery as heretofore. Confinement of the hot gases to an annular chamber of volume, with respect to hearth area, makes this controlled heating action possible without encountering difficulties through differences in pressure at various points in the heat zone and resultant impairment of combustion efficiency.

A preferred embodiment of the invention in which these features are incorporated is shown in the drawings in which:

Figure 1 is an elevational view showing part of the furnace in section and part in exterior elevation.

Figure 2 is a plan view showing part of the furnace in transverse section and part in exterior plan.

As shown in Figure 1, the furnace consists essentially of a rotary hearth indicated generally at 1 which is mounted upon a pedestal indicated at 2, the table being driven through a drive mechanism indicated at 3. An annular wall 4 surrounds the peripheral edge of the hearth and, in turn, is surmounted by a dome 5, while the hearth supports a fire wall ring 6 at its central portion which extends from the surface of the hearth to a position substantially adjacent the ceiling of the dome. The outer face of this ring 6, in conjunction with the inner face of the wall 4, and the hearth and ceiling of the dome, delineates an annular chamber designated 7 which is the zone to which hot gases are confined.

As shown in Figure 2, the burners 8 extend through the outer wall 4 of the furnace in tangential directions but these burners are located within a sector approximating about a third of the periphery of the chamber, with the charging door 9 being located between two of the burners in such manner, with respect to the direction of rotation of the hearth, that parts placed on the hearth through the door do not enter the portion of the heat zone into which the burner gases are directed until they have substantially completed a cycle of revolution on the hearth.

For sealing the gases against escape at the hearth periphery a lip 10 is provided at the outer edge of the hearth 1 while an annular ring supported from the stationary wall 4 of the furnace fits down into this lip, the latter being filled with sand so as to block the escape of gases from the edge of the hearth. Cooperating with this seal is another seal at the ceiling of the furnace, constituted by an annular groove 11 located at the top part of the ring 6 to receive a thimble 12 projecting downwardly from the furnace ceiling. The groove 11, like the lip 10, is filled with sand or suitable granulated refractory material. While it is appreciated that a groove filled with granulated material in a movable member of a furnace and a flange projecting downwardly into the groove are old in the art, the manner in which these seals are provided and their confinement of gases to an annular zone surrounding a central ring in the present construction greatly simplify the building details and make the apparatus considerably less costly. Moreover, the pair of seals, one at the hearth periphery and the other at the top of the central ring on the hearth confines the gases so effectively to the circular heat chamber that no localized zones of high pressure are encountered yet progressive heating action is obtained

through localization of the burners to a sector portion only of the heat chamber.

Vents 13 are located in the wall 4 and the other vents 14 are located in the ring 6 to provide for the escape of spent gases. These vents, it is to be noted, are located in substantially the plane of the hearth, while the burners are located substantially above the plane of the hearth. It will be seen, therefore, that the burners produce a flow of hot gases circumferentially through the heat zone, the gases sweeping over the parts on the hearth and spirally downwardly toward the discharge vents during their circumferential movement. In this manner localized heating control is provided in conjunction with very efficient combustion of the gases.

Up to the present point in the specification the main structural members of the furnace have been indicated generally more in respect to function than to structure. In more specific structural detail, the furnace in the preferred embodiment is mounted upon a base or a spider consisting of I beam members 15 arranged in the form of a cross. Vertical channel members 16 are supported from the members 15 at their extremities. A pedestal consisting preferably of a tube 17 surrounded by a pedestal support 18 rests upon the I beams 15 at the cross-over. At its upper end the post 17 is capped, as at 19, with a stud 20 extending above the cap. The table upon which the rotary hearth rests is made up of a series of arms 21 which extend radially in a plane so as to constitute a spider. The arm members 21 preferably are channel sections arranged in pairs face to face and welded to form hollow, substantially rectangular tubes as shown in Figure 1.

At the central portion of the spider a plate 22 is fastened over it and a ring 23, recessed at its central part to receive one raceway of an anti-friction bearing, extends downwardly from the central part of the plate 22. The other raceway of the anti-friction bearing is supported from stud 20. These members therefore constitute the upper journal for the table.

From the outside periphery of ring 23 a sleeve 24 depends, terminating at a point somewhat above the base 18. A ring 25 fastened to the lower end of the sleeve 24 is grooved so as to receive the outer race of an anti-friction bearing 26, the inner race of which surrounds the post 17 and rests upon the base 18. This journal constitutes the lower journal of the table. A worm wheel 27 fastened to the sleeve 24 at a point above the ring 25 is driven through a worm 28 taken from a suitable drive for rotation of the table.

Adjustable brace members 30 extend radially upwardly from a split ring 31 fixed about the sleeve 24 at a point above the worm wheel 27, to the outer extremity of each of the spider arms 21. Braces 30 consist of tubular arms 32 screw-threaded at their inner ends to be engaged by internally screw-threaded socket members 33 welded to the ring 31. Substantially shorter tubular arms 34 are welded to the outer extremities of the arms 21, in alignment with arms 32. Pins 35 screw-threaded on their inner ends and traversed by adjustment nuts 36 connect the arms 32 and 34 respectively. The outer ends of pins 35 are engaged within arms 34 and are held in place by means of collars 37. The inner or screw-threaded ends of the pins are engaged

within the outer ends of arms 32 and adjustably held in place by means of nuts 36.

A plate 38 constituting a table for supporting the brickwork of the hearth 1 is supported across the upper face of the spider made up of the members 21. A circular aperture 39 is provided in the central portion of plate 38 in alignment with the exhaust chamber provided at the interior of the central ring 6. A flow of cold air is thus provided across the bottom of the table into the area within the central ring. The cold air in addition to providing a cooling effect on the bottom of the table also provides a stack effect at the interior of the central ring, so that gases coming through the vents in the central ring are readily carried upwardly. A ring 40 surrounds the spider and encases the brickwork, part of the peripheral edge of the hearth being rabbeted annularly as at 41. A lip or seal groove 42 is fastened to the ring 40 to constitute one member of the hearth seal.

At a point just above the ledge of the rabbet 41 of the hearth an annular angle member 43 having a web 44 extending downwardly into the lip 42 is fastened to the journal members 16. A metal casing or outer wall member 45 rests upon the angle member 43 and is fastened to the journal support members 16. At the lower edge of the casing 45 a flat ring 46 extends inwardly to overlie the ledge of the rabbet of the table. This ring 46 is supported at spaced intervals by means of angular braces 47 extending inwardly from the casing. The brickwork constituting the wall 4 rests upon this ring 46, it being noted, however, that the brickwork extends to a point adjacent the peripheral face of the rabbet of the hearth and also overlies the hearth as at 48.

Above the brickwork of the wall 4 another flat ring 49 is provided to constitute a seat for supporting the brickwork of the dome 5 of the furnace.

At the upper portion of the casing 45 a second ring 50 is mounted within the casing for reinforcement and structural arch members 51 extend inwardly from the reinforcement member 50 in radial directions to carry the central vent sleeve 52. The brickwork of the dome rests at its outer edge upon the ledge 49 and against the inner face of the reinforcing ring 50, while at the central portion of the dome the brickwork abuts the vent sleeve 52. It will be seen, therefore, that the dome brickwork is self-sustaining in its intermediate portions.

At spaced intervals and preferably at positions adjacent the vertical members 16 vent flues 13 are provided in the outer wall 4, these having access to the annular chamber 7 at substantially the level of the hearth.

Upon the hearth 1 is built an annular ring of brickwork 6, a groove 11 previously referred to being provided at the top edge of the ring to receive the lower edge of vent sleeve extending downwardly below the ceiling of dome 5. As previously indicated, both the groove 11 and the lip 42 are filled with granular refractory material and provide the means for sealing the chamber 7 against the unintended escape of gas. Vents 14 previously indicated, also are built into the annular ring 6 so as to permit the escape of gases through the vent sleeve 52 at the central part of the furnace. In the preferred structure the hearth is open at the area within the confines of the ring 6, down through the level of the table 30 to the plate 22.

At spaced intervals over a sector distance em-

bracing only a portion, for example approximately a third of the periphery of the furnace, the burners 8 are installed. Flange sleeves are fastened to the casing 45 and the burners are fastened to the flanges of these sleeves in the usual manner. The angular position of the burners preferably is such that the axes of them are tangential to a circle passing substantially midway between the inner and outer walls of the annular chamber 7. Burners 8 are located substantially above the hearth and preferably approximately midway between the hearth and the furnace ceiling to cause the gases from them to take a spiral circumferential path toward the vent openings 13 and 14.

A door opening 53 having its sill at approximately the hearth level is provided in the wall 4 at a point midway between two of the burners in such manner that, in respect to the direction of rotation of the hearth, parts introduced thereon are not subjected to direct flame from any of the burners until they approach the door for discharge.

With the hearth being rotated in the direction as shown in Figure 2, it will be seen that gases from each of the burners 8a, 8b, and 8c pass over the cold pieces and that those pieces just introduced into the furnace are not subjected at any time to direct impingement of the flame upon them but instead are subjected to the most intense heat only after they have been carried approximately half-way to two-thirds of the way around the furnace. By this time they are thoroughly heated and consequently are capable of withstanding higher temperature without the development of abnormal strains. This feature is of particular utility in the heating of rods or elongated pieces which have a pronounced tendency to warp unless treated carefully.

If desirable the hearth may have grooves or slots or fixtures for supporting parts upon it. During normal operation the hearth moves slowly, permitting the operator to open the door, take out one heated piece and introduce a cold piece in its place. It is to be seen that the location of the door is such that it does not extend across the path of fire from any burner and that there is, therefore, minimum heat loss through loading and unloading operations.

Having described my invention, I desire to be limited in scope only by the claims which follow:

1. A rotary furnace, comprising a pair of walls defining an annular chamber, a dome surmounting the outermost of the walls, a rotatable table supporting the inner of the walls, sealing means for the confinement of gases between the outer wall and the table, and sealing means for confining gases between the upper part of the inner wall and the dome, and a plurality of burner means confined to a portion only of the periphery of the annular chamber and having a door located within the zone to which said burners are confined.

2. A rotary furnace comprising a rotatable spider, a circular table mounted on the spider in a horizontal plane, the circular table having a vent opening of substantial size at its central portion, a hearth built upon the table around the central opening thereof, an annular column extending upwardly from the hearth around the central opening and forming a stack therewith, with the outer face of the wall spaced inwardly from the outer periphery of the hearth, a stationary wall surrounding the periphery of the hearth, 75

a dome extending across the annular chamber between the inner face of the stationary wall and the outer face of the annular wall mounted on the hearth, sealing means between the stationary wall and the outer periphery of the hearth, and sealing means between the dome and said column, burner means for heating said annular chamber, and means for rotating said table.

3. A rotary furnace comprising a rotatable hearth, a column extending upwardly from the hearth at its central portion, with the outer periphery of the column spaced inwardly from the outer periphery of the hearth, a stationary wall surrounding said hearth and being spaced from it to permit of hearth rotation, a dome extending from the stationary wall to the said column, sealing means between the stationary wall and the hearth and between the dome and the said column for confining gases to the annular chamber therebetween, the said dome being open at its central portion and the said column being provided with vent means extending from the annular chamber to the interior of the column for passage of gases upwardly through the column and through the opening in the dome, and burner means for projecting flame into said annular chamber.

4. A rotary furnace comprising a hearth arranged for rotation in a horizontal plane, a stationary wall surrounding said hearth, a column of brickwork mounted on said hearth at its central portion and extending upwardly therefrom, with the outer face of said column being spaced inwardly from the inner face of the said stationary wall to delineate an annular heating chamber therebetween, a dome extending from the stationary wall to the column for closure of said annular chamber, sealing means between the hearth and stationary wall and between the dome and column for permitting the hearth and column to be rotated while preventing the escape of gas from the said annular chamber, a door extending through the stationary wall into the annular chamber and burner means confined to a portion only of the periphery of the annular chamber at the portion thereof adjacent said door.

5. A rotary furnace comprising a hearth arranged for rotation in a horizontal plane, a stationary wall surrounding said hearth, a column of brickwork mounted on said hearth at its central portion and extending upwardly therefrom, with the outer face of said column being spaced inwardly from the inner face of the said stationary wall to delineate an annular heating chamber therebetween, a dome extending from the stationary wall to the column for closure of the annular chamber, the said stationary wall overhanging said hearth and having means forming a seal therewith, the said column having an annular recess in its upper end and a skirt member depending from said dome into said recess.

6. A rotary furnace comprising a hearth arranged for rotation in a horizontal plane above floor level, a column extending upwardly from the central portion of the hearth with the outer face of the column being spaced inwardly from the periphery of the hearth to delineate a heating chamber therebetween, the said column and hearth having an opening passing therethrough providing a stack, a stationary wall surrounding the hearth, a dome extending from the stationary wall to the said column and being opened at its central portion to permit discharge of gases from the stack, sealing means extending between said dome and upper portion of said column, and vent

means extending through the column from the said heating chamber to the stack.

7. A rotary furnace comprising a spider, a hearth carried by the spider in a horizontal plane above floor level, means for rotating said hearth, a column extending upwardly from the central portion of the hearth with the outer periphery of the column being spaced inwardly from the periphery of the hearth, a stationary wall surrounding the hearth, with an annular portion of said wall marginally overhanging the hearth at its periphery, and a dome extending from the stationary wall to the said column, the said spider being made up of radially disposed legs which are adjustable as to length, whereby changing the length of the legs alters the plane of rotation of the hearth such that a predetermined clearance between the hearth surface and the overhanging portion of said stationary wall may be obtained.

8. A rotary furnace comprising a hearth ar-

5 ranged for rotation in a horizontal plane above floor level, a column extending upwardly from the central portion of the hearth with the outer periphery of the column being spaced inwardly from the periphery of the hearth, the said column and hearth having an opening passing therethrough providing a stack, a stationary wall surrounding the hearth, a dome extending from the stationary wall to the said column and being opened at its 10 central portion to permit discharge of gases from the stack, and vent means extending through the column from the annular cavity between the column and the stationary wall into the stack, said column having an annular groove at its upper end 15 filled with refractory particles and a ring extending from the dome into the groove so as to constitute a gas seal at the top of the said annular chamber.

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