July 30, 1946. W. ROTH 2,404,986

ROTATORY HEARTH FURNACE

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Fig. 1.

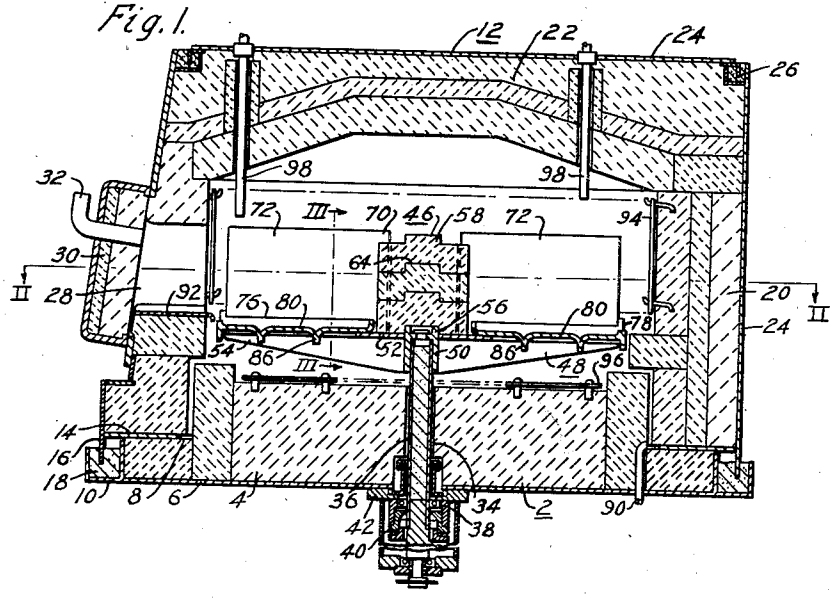


Fig. 2.

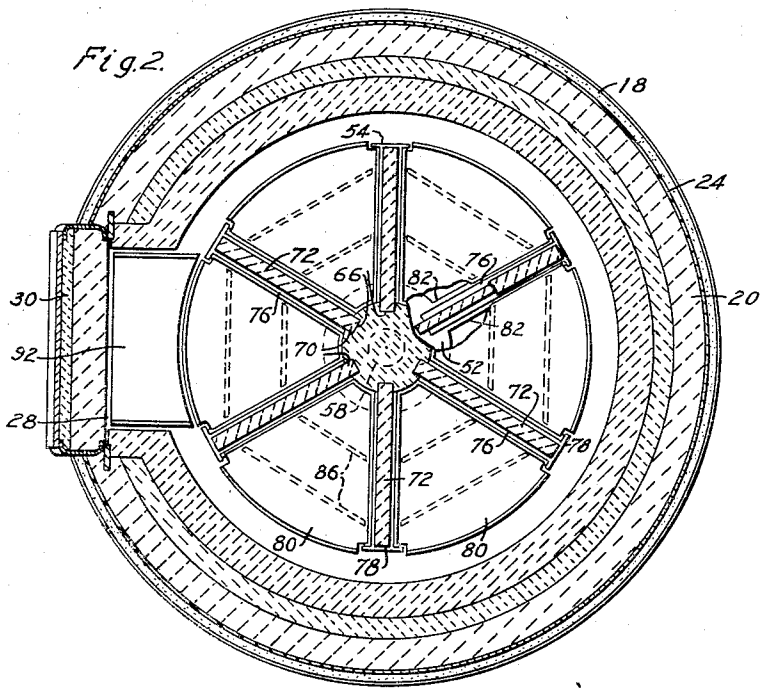
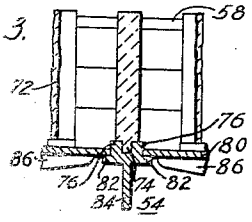


Fig. 3.



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ROTATORY HEARTH FURNACE

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My invention relates to rotatory hearth heat-treating furnaces, especially furnaces permeated by a special gas-atmosphere which envelops the metal or work being heat-treated; and has many objects, innovations, and features, amongst which are the provision in such a furnace of a plurality of different temperature control zones, of a single work-opening through which charges to be heat-treated can be inserted into the furnace and removed after heat-treatment; and of means associated with the hearth for heat-segregating the charges on the hearth so that an incoming cold charge will not unduly chill another heated charge on the hearth.

The invention will be understood from the following description of a preferred embodiment, which is to be taken in connection with the accompanying drawing, in which:

Figure 1 is a vertical sectional view of a preferred embodiment of my invention;

Fig. 2 is a horizontal sectional view taken substantially on the line II—II of Fig. 1, with parts broken away to show a section of a spider in the hearth-structure; and

Fig. 3 is a vertical sectional view of a detail taken substantially on the line III—III of Fig. 1.

The furnace representing the preferred embodiment of my invention which is shown in the drawing, but to which I am not limited, is of the bell-type comprising a lower part on which may be removably lowered an upper heating bell, so as to form an enclosed heat-treatment chamber which may be permeated by a gaseous atmosphere.

The lower part comprises a circular stationary bottom-well 2, supported above floor level in any suitable manner, and comprising heat-insulating and resisting tile 4, and an outer gas-impervious metal casing-portion 6. The tile 4 is provided with an outer circular step 8, and the metal casing-portion 6 is provided with a peripheral sealing trough 10, for receiving the bottom of a heating bell 12.

The heating bell 12 has a lower wall-supporting annular plate 14, which rests on the step 8, and a peripheral lip 16 which immerses in a sealing medium 18, which may be a liquid, sand or other suitable material, in the sealing trough 10 in order to seal the joint between the separable bottom-wall and heating bell against gas-leakage. The heating bell 12 further comprises a cylindrical side-wall 20 supported on the plate 14 and bridged at the top by a top-wall 22. The bell also comprises an outer metallic casing-portion 24, the lower part of this casing-portion pro-

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viding the sealing lip 16. The bell-walls 20 and 22 are constructed in any suitable manner customary to the art, and the part of the casing-portion 24 on the outside of the top-wall may be made of cooperating parts provided with a gas-sealing joint 26 to allow for expansion and contraction. A single work-opening 28 is provided in the heating bell 12, closable by a sliding door 30 provided with a gas-vent 32.

The bottom-wall 2 has a central opening 34 through which extends a rotatory vertical shaft 36 supported in spaced guide and supporting bearings 38 which are below the bottom-wall tile 4 so that the bearings are heat-insulated from the heat-treatment chamber. The shaft-guiding means is suitably gas-sealed to the casing-portion 6 by means comprising a suitable gas-sealing gland 40; and a dust cap 42 prevents dust from falling into the bearings.

The shaft 36 has an end protruding above the bottom-wall 2, to which is attached a hearth for a charge-supporting means, indicated in its entirety by the reference numeral 46.

The charge-supporting means 46 includes a refractory metal-alloy spider 48 comprising a socket 50 fitting and keyed or otherwise locked to the protruding end of the shaft 36, so that the spider and parts carried thereby are supported by the shaft for rotation therewith. Extending horizontally from the socket 50 is a small central horizontal hub 52 from which radiate a plurality of radial arms 54 equally spaced circumferentially, there being six such arms in the spider shown, dividing it into six sector-shaped spaces. The spider also includes a short annular lip 56 projecting above the circular hub 52.

A central tier of superimposed refractory bricks 58 is carried on top of the hub 52, each of the superposed bricks having a lower groove and an upper tongue providing interlocking joints 64 for the bricks of the tier, the lowermost groove interlockingly fitting the lip 56 of the spider. Each brick is provided with six circumferentially equally spaced slots 66, similarly located slots in the bricks being vertically aligned to form an elongated groove in the brick tier for receiving a vertical edge 70 of an upstanding non-metallic heat-insulating refractory rectangular tile 72. Each tile is also formed with a lower horizontal tongue 74 which seats in a groove provided by lengthwise extending spaced flanges 76 of the arms 54, there being six such upstanding tile 72 radiating outwardly from the brick tier, each carried by an arm 54. Each arm 54 comprises an upper lug 78 at its outer peripheral end which laps the outer

part of the tongue 74 of the associated tile 72 for limiting outward displacement thereof. The tongue and groove joints at the lower and inner edges of each tile 72, and the associated lug 78 keep the tile 72 in place.

The charge-supporting means also comprises a plurality of sector-shaped refractory metal alloy floor-plates 80, each removably resting on a seat comprising a portion of the hub 52 and flanges 82 extending outwardly from facing sides of adjacent arms 54, there being six such plates 80 in the embodiment shown. Each lug 78 is circumferentially long enough to engage corner edges of an associated pair of these plates to prevent outward displacement thereof. The spider may be strengthened by upright gusset plates 84 below each arm, tapered from the bottom of the socket 50 to the outer tip of the arm; and reinforcing webs 86 may be provided on the lower side of each alloy plate 80.

Each tile 72 has a height which is substantially that of the work-opening 28, but is significantly below the top-wall 22 so that a special atmosphere admitted through a plurality of gas inlets 90 can freely envelop a charge on each sector-plate 80, by flowing between the partition-tile 72. A small amount of the atmosphere in the heat-treatment chamber can be vented through the vent 32, and through crevices between the door 30 and the door jamb of the outer casing portion 24, for keeping the atmosphere in the furnace clean and pure. If desired or convenient, perforated plates 88 can be utilized so that the atmosphere flows therethrough.

Preferably the bottom of the work-opening 28 comprises a charge-plate 92 about on a level with the charge-supporting sector-plates 80, and the work-opening itself is of a size substantially the same as the charge-receiving space provided between any two consecutive partition-tile 72.

Heating means comprising side-wall heating units 94 supported by and around the cylindrical wall 20 and bottom-wall heating units 96 supported by and around the top of the bottom-wall 2, between it and the charge-supporting means 46, heat the heat-treatment chamber.

The partition-tile 72 divide the hearth into six charge-receiving spaces, each associatable, in turn, with the work-opening 28 when the shaft 36 is intermittently rotated. By providing the heat-insulating partition-tile, it is possible to take a charge from a sector-plate 80 through the work-opening 28 and reinsert a cold charge on the same sector-plate, without movement of the hearth and without undesirably chilling or thermally shocking a heated charge in an adjacent charge-receiving space. Prior rotatory hearth furnaces customarily provided a hearth and separate doors through a first of which a hot charge was removed and through the other a new charge inserted, a fixed heat-insulating baffle between the charge-inserting and charge-removing doors preventing the cold charge from unduly chilling the adjacent hot charge.

My invention has the further advantage that the different sector-plates 80, the refractory tile 72, and the central brick 58 can be individually inserted and withdrawn through the single work-opening 28. If it should be necessary to replace or repair the spider 48, the bell 12 can be raised.

The dividing of the hearth by the partition-tile 72 into a plurality separate heat-treating compartments, each open at the top and outerside and capable of receiving a charge, also permits me to zone the heating elements around the circular

path of movement of a charge. For example, the first 180° or 240° of movement of the charge can be devoted to a heating-up zone where the heating elements are somewhat concentrated so as to supply more heating energy in order to bring the charge up quickly to a soaking temperature, at which temperature it can be maintained by less concentrated heating elements while moving from the 240° point back to alignment with the work-opening. A pair of thermocouples 98 located in each of the different heat-treating zones may respectively control the supply of electrical energy to the heating elements for each zone.

I claim as my invention:

1. A heat-treating furnace comprising, in combination, a rotatory charge-supporting means, wall-means about said charge-supporting means, providing a heat-treatment chamber, heating means for heating said heat-treatment chamber, said wall-means being provided with a single work-opening to said heat-treatment chamber providing the sole means of access to said charge-supporting means for placing a charge thereon and removing it therefrom, and a plurality of spaced refractory heat-insulating partitions supported by and movable with said charge-supporting means, said partitions being circumferentially spaced to provide a plurality of segregated charge-receiving spaces on said charge-supporting means, said charge-supporting means comprising a plurality of floor-portions, said partitions and floor-portions being removably held in place, and comprising parts insertable through said single work-opening.

2. A heat-treating furnace comprising a heat-insulating bottom-wall, heat-insulating upper wall, including a top-wall, cooperating with said bottom-wall to provide a heat-treatment chamber, heating means for heating said heat-treatment chamber comprising electrical heating elements supported on said bottom-wall, said bottom-wall having a central opening, an upstanding rotatory shaft in said central opening, passing below said bottom-wall and above said heating elements, bearing means for said shaft, said bearing means being heat-insulated from said heat-treatment chamber by said bottom-wall, a charge-supporting means carried by said shaft above said heating elements, said upper walls being separable as a unit from said bottom-wall and said charge-supporting means, a gas-sealing means for sealing the joint between said upper walls and said bottom-wall, gas-inlet means for delivering a special gas-atmosphere to said heat-treatment chamber, and means about said shaft for limiting gas-leakage through said central opening.

3. A heat-treating furnace comprising heat-insulating wall-means, including a bottom-wall, defining a heat-treatment chamber, said bottom-wall having a central opening; a rotatory shaft in said central opening passing below said bottom-wall; charge-supporting means carried by said shaft for rotation above said bottom-wall; and separating means including heat-insulating radial upright partitions carried by said charge-supporting means, providing a plurality of separate generally sector-shaped charge-receiving spaces, said separating means including a central-member from which said partitions radiate, said central-member and said partitions being interlocked.

4. A heat-treating furnace comprising heat-insulating wall-means, including a bottom-wall,

defining a heat-treatment chamber, said bottom-wall having a central opening; a rotatory shaft in said central opening passing below said bottom-wall; charge-supporting means carried by said shaft for rotation above said bottom-wall; and separating means including heat-insulating upright partitions extending radially outward from the central portion of said charge-supporting means, providing a plurality of similar generally sector-shaped charge-receiving spaces, said wall-means being provided with a single work-opening substantially conforming to a peripheral end of one of said charge-receiving spaces, said charge-supporting means comprising a plurality of sector-shaped floor-portions, said floor-portions and said partitions being removably held in place and comprising parts insertable through said single work-opening.

5. In a rotatory hearth furnace, a generally round charge-supporting hearth, means for rotatably supporting said hearth, an upstanding heat-insulating refractory wall-means supported by said hearth for rotation therewith, said upstanding wall-means comprising radial partitions dividing said hearth into a plurality of adjacent charge-receiving spaces around the hearth, said charge-supporting hearth comprising a metallic

spider having radial arms, said partitions and arms being formed to provide interlocking joints therebetween.

6. An electrical heat-treating furnace comprising heat-insulating wall-means including an insulated bottom-wall and a separable inverted heating bell defining a heat-treatment chamber, said bell having opening means through which charges can pass; said bottom-wall having a central opening; an upstanding rotatory shaft in said central opening passing through said bottom-wall and terminating inside said heat-treatment chamber; means below said bottom-wall for rotating said shaft; a metallic charge-supporting member carried by said shaft for rotation in said heat-treatment chamber above said bottom-wall, the central part of said member and the top of said shaft being provided with cooperating detachable securing means; and partition means carried by said member, comprising a plurality of heat-insulating radial upright partitions providing a plurality of separate generally sector-shaped charge-receiving spaces; said opening means of said bell consisting of a single door through which charges are placed into and removed from each of said sector-shaped spaces.

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