

No. 655,418.

Patented Aug. 7, 1900.

R. SCHORR.
FURNACE.

(Application filed Jan. 18, 1900.)

(No Model.)

2 Sheets—Sheet 1.

Fig. I

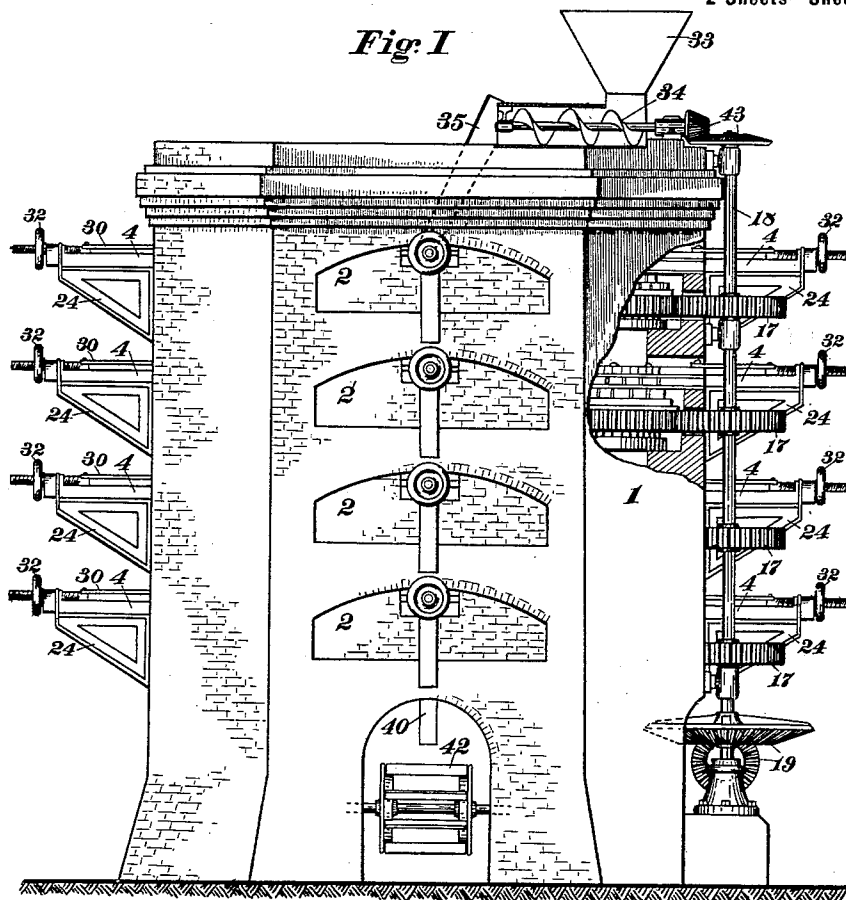


Fig. IV

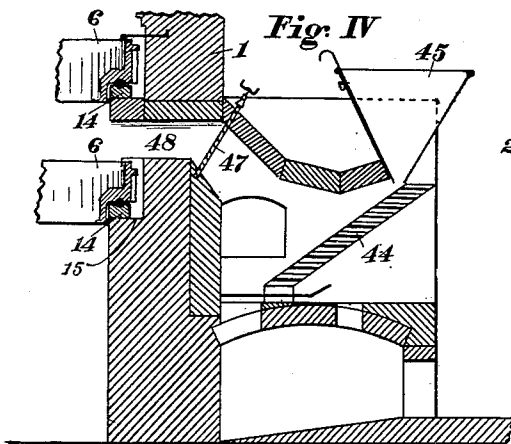
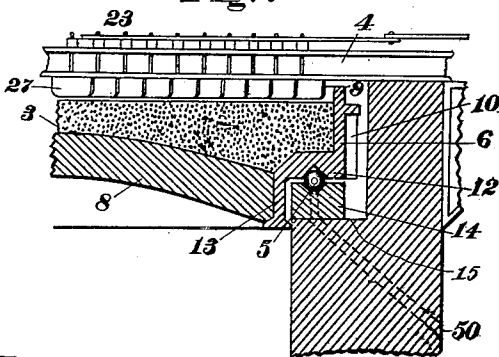


Fig. V



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No. 655,418.

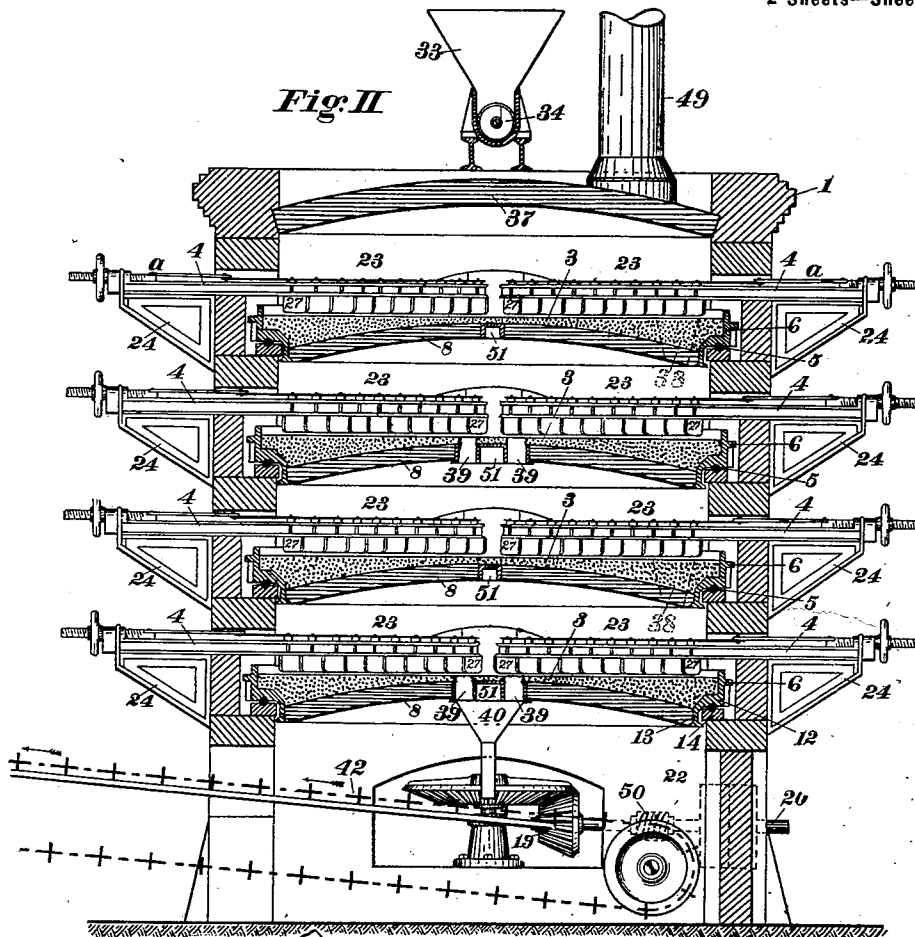
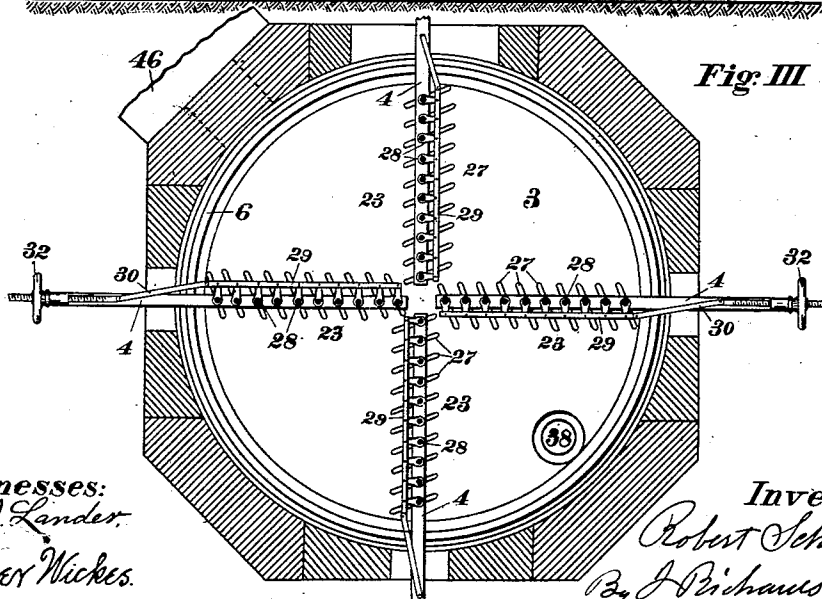
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2 Sheets—Sheet 2.



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UNITED STATES PATENT OFFICE.

ROBERT SCHORR, OF SAN FRANCISCO, CALIFORNIA.

FURNACE.

SPECIFICATION forming part of Letters Patent No. 655,418, dated August 7, 1900.

Application filed January 18, 1900. Serial No. 1,926. (No model.)

To all whom it may concern:

Be it known that I, ROBERT SCHORR, a citizen of the United States of America, residing at San Francisco, county of San Francisco, and State of California, have invented certain new and useful Improvements in Furnaces; and I hereby declare the following to be a full, clear, and exact description of the same, reference being had to the accompanying drawings, forming a part of this specification.

My invention relates to furnaces for calcining or roasting or drying mineral or other substances, especially metallic ores, and to certain useful improvements in such furnaces.

My invention consists in various features of construction and a manner of operating such furnaces that can be summarized as follows: The disposition of the roasting area in a series of circular revoluble hearths superimposed so as to occupy ground area as for one hearth only; the revoluble hearths supported and driven at or near their periphery on circular ways that rest on but are not connected to the main furnace-walls; supporting the hearths on rolling bearings that are protected from flame and high temperature; machinery to revolve in concert the series of hearths by engaging their perimeter beyond or outside of the highly-heated portions of the furnace; the revoluble hearths provided or made integral with spherical arches forming a reverberating roof for the next succeeding furnace below; so arranging the rabbles, driving-gearing, and other perishable parts as to be completely accessible for renewal or repairs; provision to compensate or eliminate the effects of expansion and contraction of the metallic parts and disturbance of the masonry thereby, and stationary stirring-rabbles that are supported adjustable, removable, and renewable from the exterior of the furnace.

My invention also consists in other features hereinafter more fully described in connection with the drawings illustrating an application of my invention in practice.

The objects of my invention are to simplify and reduce the cost of furnaces for oxidizing, roasting, and drying ores or other material and to add to their efficiency and endurance; to reduce the ground area occu-

pled, that being inversely as the number of hearths employed; to reduce in proportion to the hearth-surface the area of the external inclosing walls exposed to radiation; to remove from the main walls of the permanent structure and parts connected thereto the effects of expansion and contraction; to attain a simple and accessible means of externally operating the revoluble hearths without exposing the machinery to high temperature; to avoid a central shaft or other axial devices that would have to be protected from heat or be destroyed thereby; to maintain compression and consequent stability of the arches over the hearths by a disposition of the masonry and metallic parts with relation to their temperature; to reduce the amount of fuel required for treating ores and for other substances; to prevent by baffling-surfaces the escape of dust or fine material from the furnace, also thereby retard combustion and intensify the effect of the fuel, and to provide for fixed rabbles or stirring devices externally mounted, cooled, and operated.

To these ends I construct roasting or calcining furnaces as shown in the drawings.

Figure I is an elevation of a roasting or calcining furnace constructed according to my invention. Fig. II is a vertical section through the center of the same furnace, showing manner of constructing the same. Fig. III is a transverse section through Fig. II on the line *a a*. Fig. IV is a detail in section showing an auxiliary heating-furnace or fire-box. Fig. V is an enlarged cross-section through the main embracing-ring of the hearths and adjacent parts.

Similar numerals of reference indicate corresponding parts in the several figures of the drawings.

In calcining, roasting, or drying it is necessary that the material be distributed in a thin stratum and be continually stirred, demanding a continuous movement of either the hearth on which the ore is treated or of the stirring mechanism commonly called "rab-
bles." With rectilinear movement of the hearths or rabbles, even when there are two hearths one above the other, a large area of floor-space is required and the furnace structure if not separated transversely into sections is subjected to the sum of expansion

and contraction by heat, and is thereby soon deranged. There is also the difficulty of maintaining metal parts exposed to high temperature and to oxidation by the sulfur in the ores, demanding that all metal parts—such as bearing-ways, rabbles, and so on—be either protected from the heat and sulfur or so constructed as to be renewable without disturbing the furnace and, if possible, without stopping its operation.

A furnace constructed according to my invention consists of a structure 1, of masonry, circular in the interior and preferably polygonal on the outside, pierced with arched apertures 2 on four sides, forming the main inclosing structure, hereinafter designated the "furnace."

Concentric within the furnace 1 I mount a series of revoluble hearths 3, one above the other and as many in number as the size and stability of the furnace 1 will permit or as the area of hearth and other requirements of operating may demand. I have for purpose of explanation here shown four hearths in the drawings.

To avoid shafts or other axial supporting devices inaccessible or liable to be destroyed by heat and oxidation, the hearths 3 are supported, guided, and driven at their periphery on the circular ways arranged to receive rolling bearings, preferably balls 5 in angular grooves, as shown in Fig. V, these being preferable, because constituting complete lateral guidance and better capable of protection from heat and dust. These balls 5 are made of hard material in the usual manner, bearing at the sides in grooves above and below, as seen in Figs. II and IV, and are arranged for dry or graphite lubrication, as hereinafter explained.

The hearths 3 are composed of three main elements or parts—strong embracing-rings 6, that may be whole or formed in segments bolted together, central metallic members 51, the purpose of which will be hereinafter explained, and the spherical arches 8, constructed of refractory masonry and covered with ganister or other suitable material to withstand the heat.

The main embracing-rings 6 of the hearths 3 and arches 8 are made with a cross-section, as seen in Fig. V, providing members as follows: a flange 9, forming a curb around the hearths 3, a circular toothed rack 10, by means of which the hearths are driven, the bearing-way 12, and the internal flange 13 to protect the rolling bearing on which the hearth is supported, also forming an abutment for the arched masonry 8.

The runways 14 rest on the annular ledges 15, formed in the masonry, and not being positively attached to the walls of the main furnace 1 the main ring 6 and the runways 14 are free to expand and contract without disturbing the main walls of the furnace 1.

The revolving hearths 3 are preferably driven in unison by means of the external

spur-wheels 17 on a vertical shaft 18, that is in turn driven by bevel-gearing 19, a shaft 20, and pulleys 22, or in any other suitable manner of connecting to the motive power, in which manner it will be seen that none of the driving-gearing is exposed to high temperature, and being on the outside of the furnace is accessible for inspection and care.

Referring now to the stirring devices or rabbles 23, these are stationary, supported on the brackets 24, attached externally to the walls of the furnace 1 and reach inward nearly to the center of the hearths 3. The main bars 4 of these rabbles 23 may be solid or of any suitable section or hollow, if required, and water or air circulated to keep them cool when the temperature is destructive.

I do not illustrate water or air circulating devices here or elsewhere about the furnace, this expedient being well understood and applicable wherever sections can be made hollow and the heat is sufficiently intense to require it.

On the rabble-bars 4, here shown of channel-bar section, are mounted a series of vertically-pivoted vanes 27, that are set in an oblique position, as seen in Fig. III, so as to move the material on the hearths 3 outward or inward, as will be hereinafter explained. These vanes 27 are operated by short cranks 28, adjusted by the bars 29, the links 30, and hand-wheels 32, as shown in Fig. III.

In case of derangement of the rabbles the main bars 4 are detached from the brackets 24 and are drawn out of the furnace and are repaired or substituted without stopping the furnace, the other three in the set performing the required work during such interval.

Referring now to operative features, the ore or material to be calcined or dried is supplied to a hopper 33 and by the action of a helical conveyer 34 and a spout 35 passes through the stationary upper arch 37, forming the top of the furnace, and falling on the first revoluble hearth is gradually distributed over this hearth and conveyed to the outer edge thereof by the rabbles 23. At the outer edge of the upper hearth after preliminary heating the material falls through an aperture 38, (indicated by dotted lines in Fig. II,) descends to the next hearth, where the rabble-vanes having an opposite inclination to those on the upper hearth gradually direct the material inward toward the center, where it falls through the apertures 39 to the next hearth below. This operation is repeated from hearth to hearth, the material moving alternately outward and inward on the hearths down to the last one at the bottom, where it is discharged through a hopper-spout 40 to a conveyer 42, and is conducted to a place of storage or for further treatment. The conveyer 34 is driven from the top of the shaft 18 by means of bevel-gearing 43, as seen in Fig. I, and the conveyer 42 can be driven from the shaft 20 by tangent-gearing, as indicated at 50 in Fig. II, or in any other convenient manner.

In treating sulfurous ores the combustible matter contained in the material usually supplies the required fuel for calcining or roasting, but in case this is not sufficient I provide one or more auxiliary means of heating, as shown in the section Fig. IV, and connected to the several hearths of the main furnace 1, as indicated at 46 in Fig. III. The sectional view in Fig. IV shows in detail the mode of applying said means to one of the hearths, of which the others would be a repetition. These auxiliary fire-boxes, which may be of any of the well-known forms, are preferably made with inclined grates 44, a fuel-hopper 45, and a valve or damper 47 to close the flue 48, through which the heat and gases of combustion pass to the top of the lower hearth, as indicated in Fig. IV. In some cases, as in drying coal, for example, when there is danger of ignition and explosion of the combustible gases, hot air can be forced into the furnace by means of the usual twyers.

The spherical arches 8 beneath the hearths 3 are constructed of brick covered with ganister or any suitable refractory material, and are kept in a state of compression by the difference in temperatures between the masonry and the metal. The expansion being relatively as two to five and the temperature of the masonry having such proportion to that of the embracing-ring 6, produces, approximately, an equilibrium and avoids disturbance and fracture of the arches, except about their center, at which point is inserted a metallic key or center-piece of metal 51, which by excess of its expansion serves to support the immediately-surrounding masonry of the arch. A chimney 49 is provided at some point in the arch 37 to carry off the smoke and gases from the main furnace. The tortuous and circuitous course of the gases of combustion in passing from hearth to hearth baffles and causes precipitation of the flue-dust and avoids a considerable loss common to direct flues, as in longitudinal furnaces.

To lubricate the rolling bearings beneath the hearths, I provide the usual means of supplying graphite that is distributed among the balls; also, provide a number of waste-passages, such as indicated by dotted lines at 50 in Fig. V, leading from the bottom runway 14, through which dust, abraded matter, or the exhausted lubricant can escape through the wall of the main furnace.

It will be seen that a furnace constructed in the manner described is adapted for drying, as well as calcining or roasting, ores or other substances and can be so employed without material change for drying any kind of material by the aid of fuel or hot air, and thus serve alternate purposes when not occupied in calcining or roasting.

Having thus explained the nature and objects of my invention and the manner of its application in practice, what I claim as new, and desire to secure by Letters Patent, is, in a roasting or drying furnace, the following

devices or others substantially the same in their relations and manner of operating:

1. In a furnace, a masonry wall of interior cylindrical form, a vertical series of independent revoluble hearths set concentric therein, interior ledges on said masonry wall for supporting said revoluble hearths by their peripheries, ball-bearings and runways between said supports and said peripheries, means for shielding from the interior heat the said bearings and runways, means exterior to said shielded bearings for rotating said hearths by their peripheries, and means for stirring ore on the revolving hearths, substantially as specified.

2. In a furnace, a masonry wall of interior cylindrical form, a vertical series of independent revoluble hearths set concentric therein, means for revolubly supporting said hearths by their peripheries, sustained on said masonry wall, depending flanges on the revoluble hearths for shielding the revoluble supports from the internal heat, peripheral toothed racks on the said hearths outside said depending flanges, spur-gears in engagement with said toothed racks, with means to rotate the same simultaneously, and means for stirring ore on the revolving hearths, substantially as specified.

3. In a furnace, a masonry wall of interior cylindrical form, a vertical series of independent revoluble hearths set concentric therein, rolling bearings beneath the peripheries of said hearths, and circular runways under said bearings, resting on but not attached to ledges formed in said wall, whereby said runways are free to expand and contract without disturbance to the said furnace-wall, substantially as specified.

4. In a furnace, an inclosing masonry wall of interior cylindrical form, a series of superposed independent revoluble hearths set concentric therein, the peripheries of said hearths being metallic rings, the interiors of said hearths being spherical arches of refractory material confined and supported by said rings, rolling bearings under said rings, runways under said bearings sustained by the inclosing wall, means for rotating said rings on said bearings by engagement with the peripheries of said rings, and means for stirring the ore on said revolving hearths, substantially as specified.

5. A furnace having a main inclosing masonry wall of interior cylindrical form, a series of superposed independent revoluble hearths set concentric therein, consisting of spherical arches of refractory material surrounded by peripheral metallic rings supporting the same, rolling bearings under said peripheral rings, runways for said bearings, and depending flanges on said peripheral rings covering and shielding said bearings and runways from the internal flame, substantially as specified.

6. A furnace having a main inclosing wall of interior cylindrical form, a series of super-

posed independent revoluble hearths set concentric therein, consisting of spherical arches of refractory material surrounded by peripheral metallic rings supporting said arches, rolling bearings under said peripheral rings, sliding runways under said bearings, resting on but not secured to ledges formed in said masonry wall, depending flanges on said peripheral rings, covering and shielding said runways and bearings and taking the thrust of said arches, curb-rings on said peripheral rings outside the bearings, toothed racks on said curb portions whereby the said rings are rotated from the peripheries, and means engaging with said toothed racks for rotating the same, substantially as specified.

7. A furnace having a main inclosing wall of interior cylindrical form, a vertical series of independent revoluble hearths set concentric therein, a series of annular grooved runways on which said hearths revolve, rolling bearings in said grooved runways, supports for the runways formed in the masonry wall, and apertures in and through said runways and wall-supports whereby dust and debris from wear may escape from the runways, substantially as specified.

8. A furnace having a main inclosing wall of interior cylindrical form, a vertical series of independent revoluble hearths set concentric therein, having peripheral metallic rings, rolling bearings under said rings whereby the hearths are revolubly supported, runways for the bearings, toothed gear-racks on the exteriors of said peripheral rings, a vertical rotary driving-shaft outside the furnace-wall, and a series of spur-gears on said vertical shaft, engaging said toothed gear-racks, whereby the hearths are rotated in unison, substantially as specified.

9. In a furnace having a main inclosing wall of interior cylindrical form, a vertical series of independent revoluble hearths of refractory material, spherically arched beneath, flat on the upper surfaces, having peripheral metallic rings by which the arched portions are confined and sustained, rolling bearings under said rings, detached sliding runways for said bearings, ledges formed in the masonry wall sustaining the said runways, depending flanges on said rings, shielding and protecting said runways, exterior curbs on said rings, toothed gear-racks on said curbs, and means external to the masonry wall engaging said racks whereby the said hearths are rotated in unison, substantially as specified.

10. In a furnace having a main inclosing masonry wall of interior cylindrical form, a vertical series of independent revoluble hearths formed of refractory material, spherically arched beneath, flat on the upper surfaces, rolling bearings supporting said hearths from their peripheries, runways under the said bearings, sustained by the masonry wall, means for protecting said bear-

ings and runways from the internal flame, and openings 38 through said hearths, forming communications between the several spaces inclosed between the same, substantially as specified.

11. In a furnace having a main inclosing masonry wall of interior cylindrical form, a series of superposed independent revoluble hearths formed of refractory material set concentric therein, arched beneath and flat on the upper surfaces, forming a series of reverberatory chambers between them, means for sustaining said hearths revolubly by the peripheries thereof, apertures through the several hearths forming communications between said chambers, a series of fire-boxes outside the walls of said furnace communicating with said chambers respectively, and means for controlling the passage of flame from said boxes to said chambers, substantially as specified.

12. In a furnace having a main inclosing masonry wall of interior cylindrical form, a vertical series of independent circular revoluble hearths of refractory material, arched beneath, flat on the upper surfaces, peripheral rings confining and sustaining said arches, gear-toothed on their exterior margins, means for revolubly supporting said peripheral rings, and a vertical driving-shaft, set outside of said masonry wall, provided with a series of spur-gear-toothed wheels severally engaging the said toothed peripheral rings through apertures in the masonry walls, whereby all the said hearths are rotated in unison by said vertical driving-shaft, substantially as specified.

13. In a furnace having a main inclosing masonry wall of interior cylindrical form, a vertical series of independent circular revoluble hearths of refractory material, arched beneath, flat on the upper surfaces, forming a series of reverberatory chambers between the same, means for revolubly supporting said hearths from their peripheries, openings through the masonry wall into said reverberatory chambers, brackets on the outside of said wall opposite said openings, fixed stirrers sustained on said brackets, projecting through said openings into said chambers and over said hearths toward the centers thereof, adjustable vanes on said stirrers, and means outside of said walls for adjusting and setting the angles of said vanes, substantially as specified.

14. In a furnace having a main inclosing wall of interior cylindrical form, a vertical series of independent circular revoluble hearths of refractory material, arched beneath and flat on the upper surfaces, means for revolubly supporting said hearths from their peripheries, and for rotating the same, apertures through the several hearths, fixed stirrers supported outside the walls but projecting through the same and over the said hearths, and a spherical arch at the top of the struc-

ture, provided with an inlet-way for ore and an outlet-way for the products of combustion, substantially as specified.

15. In a furnace having a main inclosing
5 masonry wall of interior cylindrical form, a series of superposed independent circular revolvable hearths of refractory material, arched beneath and flat on the upper surfaces, means for revolvably supporting said hearths from
10 their peripheries, and for rotating the same, apertures through said hearths, fixed stirrers over the several hearths, having adjustable vanes, an arched top to the structure pro-

vided with an inlet-way for ore and an outlet-way for the products of combustion, a 15 central hopper and discharge-way through the lowermost hearth, and means for conveying away the treated ore, substantially as specified.

In testimony whereof I have signed my 20 name to this specification in the presence of two subscribing witnesses.

ROBERT SCHORR.

Witnesses:

ALFRED A. ENQUIST,
ELMER WICKES.