

No. 613,117.

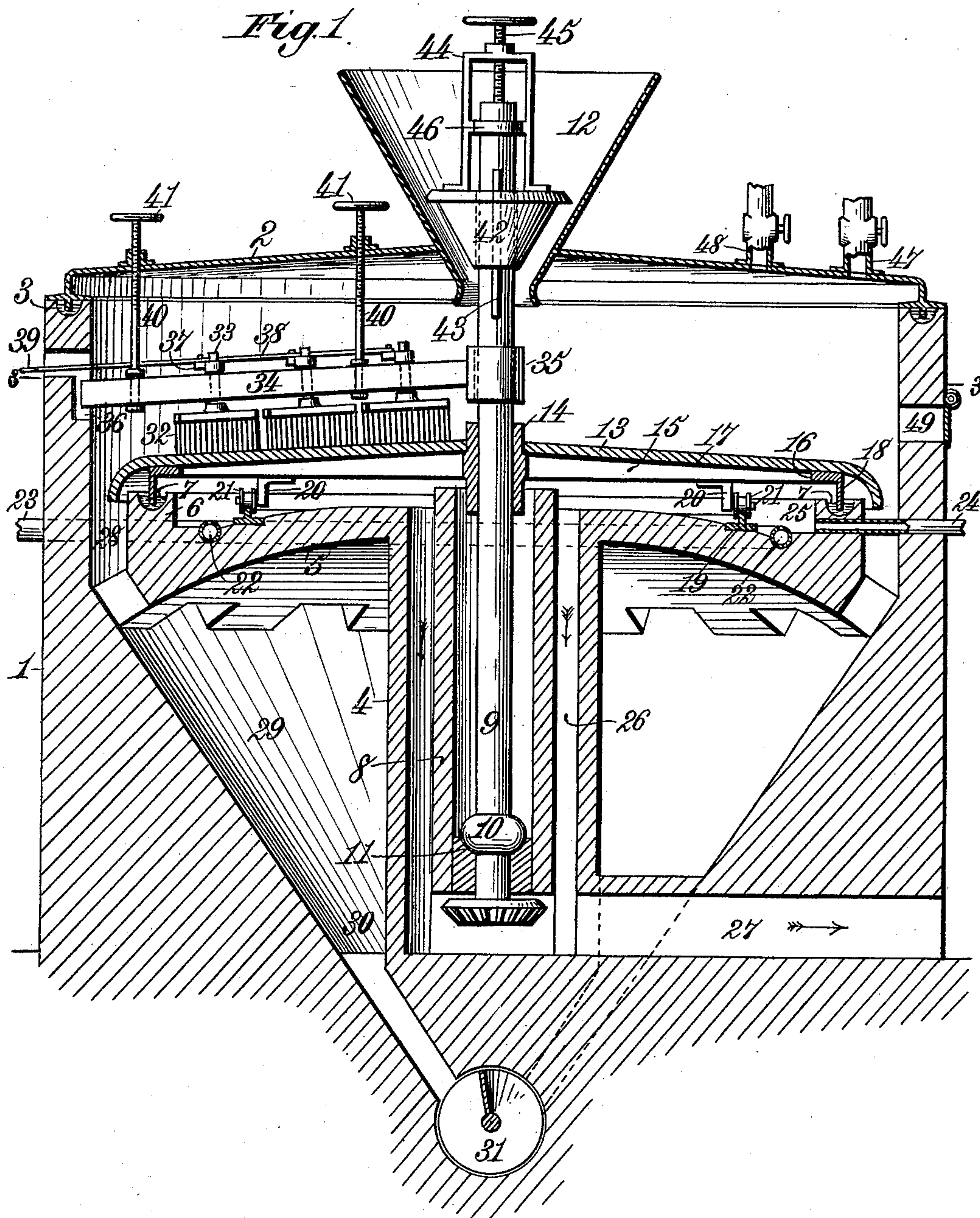
Patented Oct. 25, 1898.

J. P. CALNAN.
ORE ROASTING FURNACE.

(Application filed Oct. 29, 1897.)

(No Model.)

3 Sheets—Sheet 1.



Witnesses,
Robert Everett
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By *James L. Norris*
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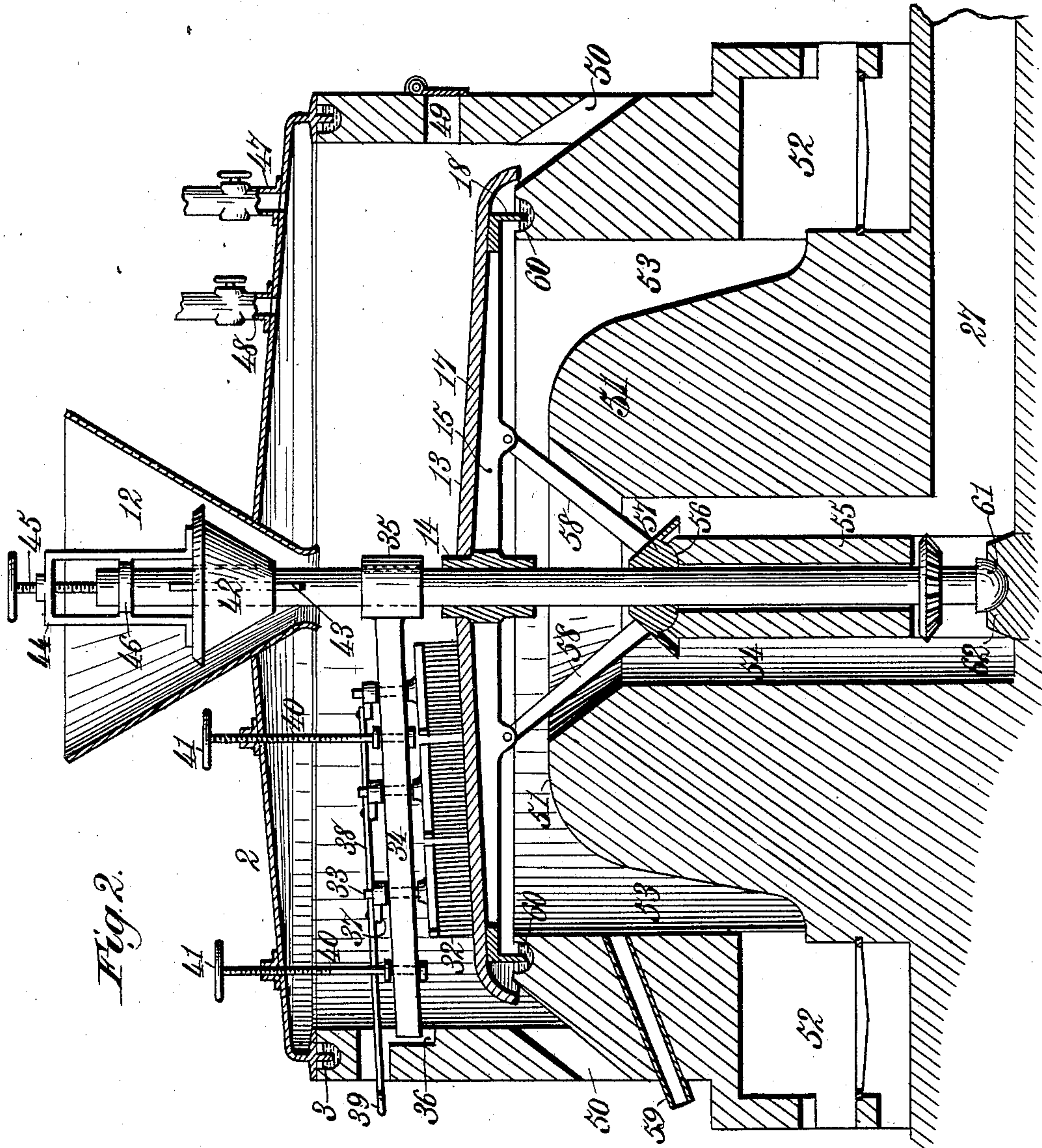


Fig. 2.

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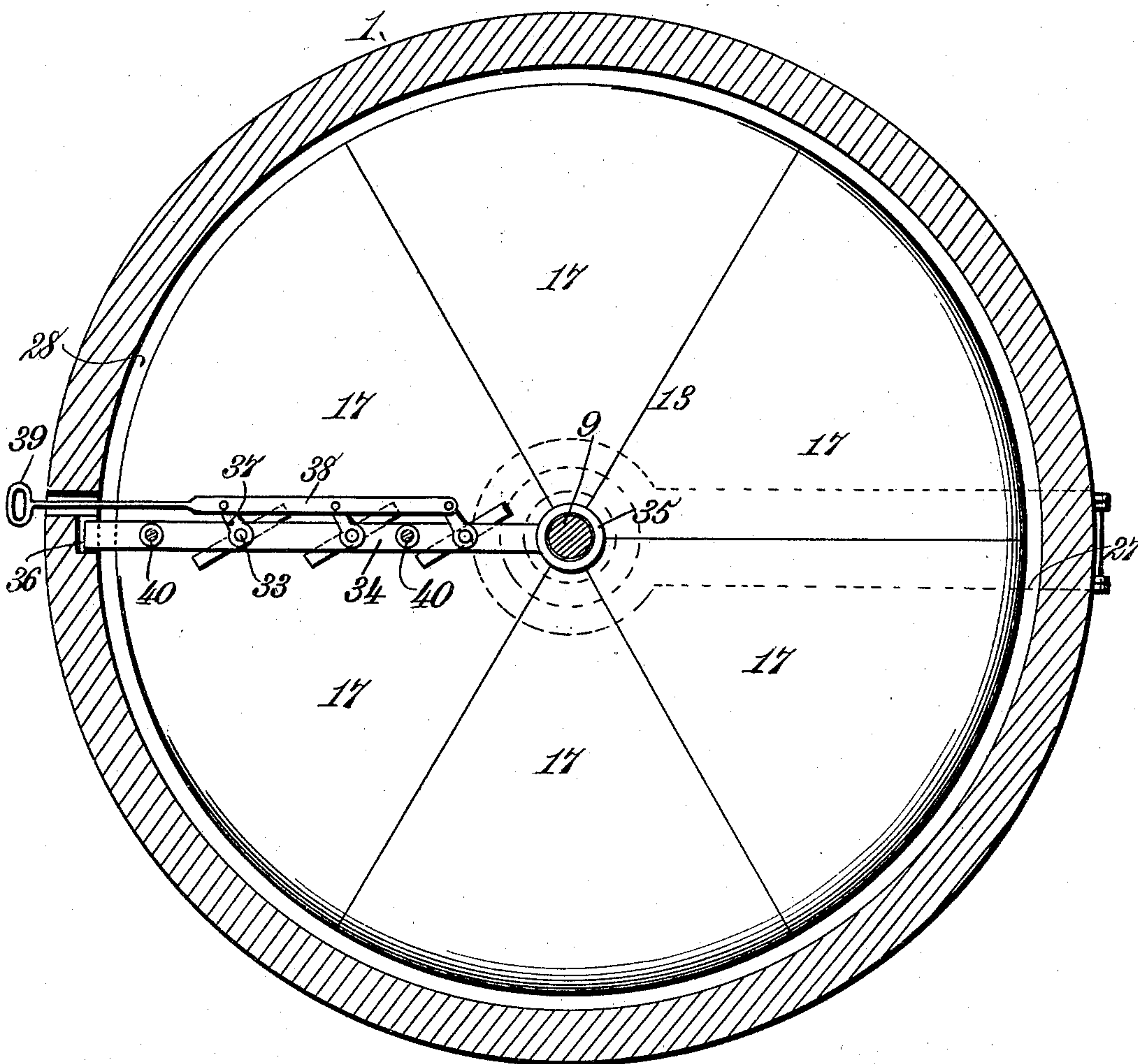
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3 Sheets—Sheet 3.

Fig. 3.



Witnesses,
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UNITED STATES PATENT OFFICE.

JAMES P. CALNAN, OF CLINTON, IOWA.

ORE-ROASTING FURNACE.

SPECIFICATION forming part of Letters Patent No. 613,117, dated October 25, 1898.

Application filed October 29, 1897. Serial No. 656,806. (No model.)

To all whom it may concern:

Be it known that I, JAMES P. CALNAN, a citizen of the United States, residing at Clinton, in the county of Clinton and State of Iowa, have invented new and useful Improvements in Ore-Roasting Furnaces, of which the following is a specification.

The chief object of this invention is to provide a new and improved ore-roasting furnace which is continuous in action and possesses novel feed mechanism for obtaining a continuous feed of the ore in properly-regulated quantities to the hearth, and the ore is stirred and uniformly spread over the hearth and is constantly discharged from the periphery thereof into a continuous annular discharge-chute.

The object of my invention is accomplished in the manner and by the means hereinafter described and claimed, reference being made to the accompanying drawings, in which—

Figure 1 is a vertical central section of my improved furnace arranged to be heated by gaseous fuel. Fig. 2 is a similar view of the furnace arranged for the consumption of solid fuel, and Fig. 3 is a sectional plan view taken on the line 3 3 of Fig. 1.

In the figures of the drawings similar reference-numerals refer to like parts.

Referring to Fig. 1 of the drawings, the numeral 1 indicates the vertical walls of the furnace, built of bricks or masonry in the usual manner and preferably circular in plan. Arranged on the top of the walls 1 is a convex or dome-shaped roof 2, the circumferential edge of which is sealed in a gutter 3 in the upper edge of the walls 1, as usual. In the center of the furnace is built a hollow column 4, supporting at its upper end a convex disk-shaped arch 5, provided upon its periphery with a vertical wall 6, in the upper edge of which is formed a sealing-gutter 7. Built concentrically within the column 4 is a hollow column 8, the upper end of which extends somewhat above the top of the arch 5, as shown. Arranged centrally in the column 8 is a vertical shaft 9, that is provided near its lower end with a globular collar 10, that is seated in a correspondingly-shaped seat 11, arranged in the bottom of the column 8. The upper end of the shaft 9 projects up

through a funnel-shaped hopper 12, fixed centrally in the roof 2, and carries an adjustable feed-regulating device, as hereinafter explained. Fixed on the shaft 9 is the rotary hearth 13, consisting of a sleeve 14, rigidly attached to the shaft in any suitable or preferred manner and formed with a plurality of radial arms 15, carrying at their outer ends an annular rim 16. The arms 15 and rim 16 constitute a grid or spider, on which is supported the floor 17 of the hearth, which is preferably formed in segmental sections of refractory material or metal, having a smooth or uninterrupted upper surface and fixed to the spider by any suitable means. As shown, the arms 15 are slightly inclined downward from their inner toward their outer ends, and hence the floor of the hearth will be slightly cone-shaped. The outer edge or circumference of the floor 13 extends beyond or over the edge of the rim 16 and is curved downward, as shown, and overhangs the vertical wall 6 of the arch 5. To the rim 16 is attached or formed integral therewith a metallic curtain or apron 18, which dips into the gutter 7 and is sealed therein with a liquid or granular material in a well-known manner. If desired, the hearth may be given additional support by arranging a circular track-rail 19 on the arch 5 and attaching to the arms 15 bracket-arms 20, having journaled on their ends wheels 21, which travel on the track-rail and serve to support a portion of the weight of the hearth and its load.

Seated on top of the arch 5 is an annular burner-pipe 22, provided with a series of jet-openings on its upper side and connected to a feed-pipe 23, which extends through the wall of the furnace and communicates with any suitable source of gas-supply. For the purpose of supporting combustion a pipe 24 extends through the furnace-wall 1 and the arch-wall 15 and admits atmospheric air to the space 25 between the arch and hearth constituting the combustion-chamber. The heat generated by the burning gas issuing from the jet-openings in the burner-pipe and the products of combustion impinges directly against the bottom of the hearth and, being prevented from escaping between the edges of the hearth and the wall 6 by the curtain 18, passes down

the flue 26 between the columns 4 and 8 into a lateral flue 27, which leads outside to the drying-pans employed for drying the ore preparatory to its being fed into the furnace.

5 The lower end of the shaft 9 projects into the flue 27, where it is connected to any suitable driving mechanism for rotating the shaft.

As shown in the drawings, there is an annular space 28 between the wall of the furnace 10 and the wall 15 and edge of the arch 5. This space constitutes a chute into which the roasted ore is discharged from the rotary hearth, and said chute discharges into the cooling-chamber 29. The cooling-chamber is provided with a funnel-shaped bottom 30, the 15 lower end of which communicates with a worm conveyer 31, arranged beneath the furnace and operating to deliver the roasted and cooled ore to a convenient point outside the 20 furnace.

Disposed over the hearth is a series of brushes 32, each of which is fixed on a vertical rod or shaft 33. The rods 33 are journaled in a brush-support, composed, as here 25 shown, of an approximately horizontal beam 34, in such manner that while they are free to be rotated in the beam they are incapable of being moved vertically independently thereof. The inner end of the beam is provided with a sleeve 35, which encircles and 30 is movable on the shaft 9, while the outer end of the beam is vertically movable in a groove 36, formed in the wall of the furnace. Fixed on the upper end of each of the rods 35 or shafts 33 is an arm 37, which at its other end is pivotally attached to a rod 38, which passes through the furnace-wall 1 and at its outer end is provided with a handle 39. It 40 will be readily understood that by pushing in or pulling out the rod 38 the brushes will be adjusted angularly relative to a radial line passing through the furnace. Swiveled in the beam 34 are screw-rods 40, which pass through suitable threaded bushings fixed in 45 the roof 2 and at their upper ends are provided with hand-wheels 41, by turning which the screw-rods are rotated and the beam 34, and with it the brushes 32, are raised and lowered.

50 The ore is fed to the furnace by the funnel-shaped hopper 12, and in order to regulate the feed I provide the following means: Arranged in the hopper 12 and free to slide vertically on the shaft 9 is an inverted cone 55 42, which is caused to rotate with the shaft by a spline 43. Attached to the cone are the arms of a yoke 44, which has fitted in its upper end an adjusting-screw 45. The adjusting-screw at its lower end rests and bears 60 against the upper end of the shaft 9, and by turning said screw the yoke, and with it the feed-cone 42, may be raised and lowered on the shaft. The bracket 44 is guided in its vertical movement on the shaft by a collar 46, 65 which is attached on its opposite sides to the two arms of the bracket and encircles the shaft. The feed-cone 42 rotates with the

shaft 9 and feeds the ore at a uniform rate down upon the hearth. It will be evident that by raising or lowering the cone the 70 space between it and the hopper will be enlarged or reduced, and hence the quantity of ore fed therethrough in a given time will be correspondingly increased or diminished.

In the roof 2 of the furnace is arranged an 75 outlet 47 for the escape of gas generated by the roasting operation, and an inlet-pipe 48 is also arranged in the roof or wall for the admission of air or steam to assist the process of roasting. 80

One or more peep-holes 49 may be conveniently arranged in the furnace-wall through which the roasting operation may be viewed.

In Fig. 2 I have illustrated a slightly-modified construction of furnace adapted for the 85 employment of solid fuel instead of gas. As shown in said figure of the drawings, the furnace and its accessories are similar in most respects to that above described; but the construction is modified in the following particulars to adapt it for the consumption of solid 90 fuel. As shown in said figure, the ore, instead of being discharged into a chute leading into a cooling-chamber beneath the hearth, is discharged over the edge of the rotary hearth into a chute or series of chutes 95 50, which pass through the walls of the furnace and convey the roasted ore to the outside of the latter and discharge it into a cooling-chamber or conveyer. (Not shown.) The 100 cooling-chamber beneath the hearth before described is in this furnace dispensed with, and an arch 51 is built centrally within the furnace and extends up to within a suitable distance beneath the rotary hearth 13, forming 105 a combustion-chamber 25. Arranged in the furnace-walls 1 are a plurality of fire-boxes 52, in which is consumed the solid fuel, and the sides of the arch 51 are curved, as shown, to form with the furnace-walls flues 53, which 110 lead into the combustion-chamber 25. The arch 51 is formed with a central well 54, and in said well is built the column 55, provided at its upper end with a concave bearing 56, in which is seated a globular collar 57, fixed on the shaft 115 9. Arms 58 are attached at their lower ends to the collar 57, and at their upper ends are attached to the spider, on which rests the floor 17 of the hearth. These arms 58 form braces which aid in supporting the hearth and its load. 120 The space in the well between the column 55 and the arch 51 forms the downtake-flue 26, which leads from the combustion-chamber 25 and conveys off the surplus heat and products of combustion from said combustion-chamber 125 to the lateral discharge-flue 27, as before described. For the purpose of supporting combustion in the chamber 25 air-inlet pipes 59 are arranged in the walls of the furnace and communicate with the atmosphere at their 130 outer ends, and at their inner ends communicate with the chamber 25. Instead of the apron or curtain 18 dipping into a sealing-gutter formed on the upper edge of the arch

beneath the hearth, as before described, it dips into a similar gutter 60, formed in the furnace-wall 1, as shown.

If preferred, the shaft 9 may be provided at its lower end with a globular foot 61, seated in a correspondingly-formed pillar-block 62 and forming an additional support or bearing for the shaft.

The operation of my improved furnace is as follows: The ore to be treated is placed in dry-pans and dried by surplus heat from the furnace, then crushed and mixed with the necessary chemicals that will produce the chemical changes desired by the application of regulated heat. The ore is then conveyed to the hopper and passed through the same to the revolving hearth. The degree of heat at this point is sufficient to cause the roasting of the ore to begin at once, and as the ore passes through the hopper to the hearth the adjustable brushes stir and convey the same while in the process of roasting to the lower edge of the hearth and finally into the cooling-chamber. While the ore is in the process of roasting hot atmospheric air or steam is introduced from time to time through the inlet-pipe 48. The heat from the burner-pipe 22 or the fire-boxes 52 is directed against the under side of the hearth 13, and after acting thereon is conveyed off, together with the products of combustion, to the lateral flue 27, by which latter it is conveyed to the drying-pans for drying the ore preparatory to its being crushed and fed to the furnace. The dried and crushed ore is placed in the hopper 12 and is fed at a uniform rate by the feed-cone 42 onto the central portion of the hearth 13. The feed may be regulated by adjusting the feed-cone 42 vertically in the manner before described. As the hearth revolves the ore is stirred up and spread over the floor thereof by the brushes 32, the depth of the layer of ore on the floor being regulated by adjusting the brushes vertically by means of the adjusting-screws 40. These brushes by stirring up and spreading out the ore successively bring fresh portions of the mass into contact with the heated hearth, and being arranged at an angle to a radial line passing through the hearth the brushes, aided by the slightly-inclined or conical shape of the hearth, successively sweep the ore toward the edge of the hearth until it finally drops over the curved or overhanging edge. The discharge of the ore over the edge of the hearth may be made continuous and uniform at will, and the rapidity with which it travels from the center of the hearth to its edge is regulated by adjusting the inclination of the brushes by pushing in or pulling out the rod 38. In the furnace illustrated in Fig. 1 the ore as it is discharged from the rotary hearth drops into the chute 28 and by the latter is conveyed down into the cooler 29. From the cooler the roasted and cooled ore is fed by gravity to the worm conveyer 31, by which it is conveyed away from the furnace.

In the furnace shown in Fig. 2 the roasted ore is discharged from the hearth into the chutes 50 and by the latter conveyed outside the furnace to a cooling-chamber or conveyer. (Not shown.)

In both furnaces the operation may be made a continuous one at will, the ore being fed at a uniform rate regulated by the feed-cone and discharged continuously at will over the edge of the revolving hearth, the rate of discharge being regulated by adjusting the inclination of the brushes.

By the combined adjustments of the feed-cone and brushes the roasting operation may be regulated with the utmost nicety. Scrapers, paddles, or the like may manifestly be substituted for the brushes.

I do not wish to be understood as limiting myself to the various details of construction shown, as it will be evident that many of the features may be modified, altered, or omitted without departing from the spirit of my invention.

Having described my invention, what I claim is—

1. In an ore-roasting furnace, the combination of a rotary hearth, a discharge-chute extending around the periphery of the hearth, a vertically-adjustable brush-support, mechanism for raising and lowering the brush-support and holding it in fixed positions of adjustment, brushes carried by said supports and angularly adjustable thereupon relatively to a radial line through the furnace, a heater and a combustion-chamber located beneath the hearth, and an offtake-flue, substantially as described.

2. In an ore-roasting furnace, the combination of a furnace structure having a continuous annular discharge-chute, a rotary hearth having its periphery arranged to deliver the ore into said continuous discharge-chute, a perpendicular rotary shaft to which the hearth is secured, a feed-hopper, a feed-regulating cone adjustable on the shaft within the hopper, a heater and a combustion-chamber located beneath the hearth, means for preventing the passage of products of combustion from the under to the upper side of the hearth, and an offtake-flue, substantially as described.

3. In an ore-roasting furnace, the combination of a furnace structure, a perpendicular rotary shaft, a rotary hearth attached to said shaft, a discharge-chute into which the periphery of the hearth discharges the ore, a feed-hopper, a feed-regulating cone adjustable on the shaft within the hopper, a heater and a combustion-chamber located beneath the hearth, an offtake-flue, and brushes adjustable vertically and also angularly with relation to a radial line through the furnace, substantially as described.

4. In an ore-roasting furnace, the combination with a rotary hearth, a heater and a combustion-chamber located beneath the hearth, means for preventing the passage of products

of combustion from the under to the upper side of the hearth, a vertically-adjustable brush-support, mechanism for raising and lowering the brush-support for holding it in its adjusted position, and brushes carried by said support and angularly adjustable there-upon relatively to a radial line through the furnace, substantially as described.

5. In an ore-roasting furnace, the combination of a rotary hearth, a perpendicular rotary shaft to which the hearth is secured, a heater and a combustion-chamber located beneath the hearth, a feed-hopper, a feed-regulating cone vertically adjustable on the shaft within the hopper, brushes arranged above the upper side of the hearth, and devices for adjusting the brushes vertically and also angularly relatively to a radial line through the furnace, substantially as described.

6. In an ore-roasting furnace, the combination of a rotary hearth, composed of a disk having a smooth upper surface inclined downward from its center to its periphery and constructed with a downwardly-curved peripheral edge, a combustion-chamber located under the hearth, brushes arranged above the hearth, and devices for adjusting the brushes vertically and also angularly relatively to a radial line through the furnace, substantially as described.

7. In an ore-roasting furnace, the combination of a furnace structure having an arch, a cooling-chamber beneath the arch and an annular continuous discharge-chute by which the material passes to the cooling-chamber, a rotary hearth from the periphery of which the material is delivered to said discharge-chute, a perpendicular rotary shaft to which the hearth is attached, a feed-hopper, a feed-regulator adjustable within the hopper, and vertically and angularly adjustable brushes arranged over the hearth, substantially as described.

8. In an ore-roasting furnace, the combination of a furnace structure having an arch, a cooling-chamber beneath the arch, an annular continuous discharge-chute by which the material passes to the cooling-chamber, a rotary hearth, a heater and a combustion-chamber located under the hearth, means for preventing products of combustion passing from the under to the upper side of the hearth, a perpendicular rotary shaft to which the hearth is attached, and brushes arranged in operative connection with the upper side of the hearth, substantially as described.

9. In a furnace, the combination with the walls and roof thereof, of a funnel-shaped hopper arranged in the roof, a vertical rotary shaft arranged centrally in the hopper, an inverted cone splined on the shaft, a yoke attached to the cone and straddling the upper end of the shaft, and a set-screw fitted in the upper end of the yoke and bearing against the upper end of the shaft, substantially as described.

10. In a furnace, the combination with the

walls and roof thereof, of a funnel-shaped hopper arranged in the roof, a vertical rotary shaft arranged centrally in the hopper, an inverted cone splined on the shaft, a yoke attached to the cone and straddling the upper end of the shaft, a set-screw fitted in the upper end of the yoke and bearing against the upper end of the shaft, and a collar attached to said yoke and encircling the shaft, substantially as described.

11. In a furnace, the combination with the wall and the roof thereof, of a funnel-shaped hopper arranged in the roof, a vertical rotary shaft arranged in the furnace and projecting into the hopper, an inverted cone splined on the shaft in the hopper, means for vertically adjusting the cone on the shaft, a rotary hearth fixed on the shaft beneath the hopper, a plurality of brushes arranged over the hearth and inclined relatively to the radii of the hearth, and means for adjusting the inclination of the brushes, substantially as described.

12. In a furnace, the combination with the wall and the roof thereof, of a funnel-shaped hopper arranged in the roof, a vertical rotary shaft arranged in the furnace and projecting into the hoppers, an inverted cone splined on the shaft in the hopper, means for vertically adjusting the cone on the shaft, a rotary hearth fixed on the shaft beneath the hopper, a plurality of brushes arranged over the hearth, and means for vertically adjusting the brushes, substantially as described.

13. In a furnace, the combination with the wall and roof thereof, of a funnel-shaped hopper arranged in the roof, a vertical rotary shaft arranged in the furnace and projecting into the hopper, an inverted cone splined on the shaft in the hopper, means for vertically adjusting the cone on the shaft, a rotary hearth fixed on the shaft beneath the hopper, a plurality of brushes inclined relatively to the radii of the hearth, means for adjusting the inclination of the brushes, and means for vertically adjusting the same, substantially as described.

14. In an ore-roasting furnace, the combination with a furnace structure having an arch, a cooling-chamber beneath the arch and an annular continuous discharge-chute by which the material passes to the cooling-chamber, a rotary hearth, a heater and a combustion-chamber located under the hearth, means for preventing products of combustion passing from the under to the upper side of the hearth, a perpendicular rotary shaft to which the hearth is attached, a vertically-adjustable brush-support, brushes having shafts journaled in said support, means for adjusting the support vertically, and means for turning the brush-shafts to angularly adjust the brushes relatively to a radial line through the furnace, substantially as described.

15. In an ore-roasting furnace, the combination of a rotary shaft, a rotary hearth secured to the shaft, a brush-support sleeved

upon the shaft and slidable vertically thereupon, brushes having shafts journaled in the brush-support, means for adjusting the brush-support vertically, and means for turning the shafts of the brushes to angularly adjust the latter relatively to a radial line through the furnace, substantially as described.

16. In an ore-roasting furnace, the combination of a perpendicular rotary shaft, a feed-hopper into which the shaft extends, a feed-regulator adjustable in the hopper, a rotary hearth attached to the shaft, an approximately horizontal beam sleeved on the shaft and vertically adjustable thereupon, brushes suspended from said beam in operative connection with the upper surface of the hearth, and adjusting-screws for vertically adjusting the said beam, substantially as described.

17. In an ore-roasting furnace, the combination of a perpendicular rotary shaft, a rotary hearth attached to said shaft, an approximately horizontal beam sleeved upon the shaft and vertically adjustable thereupon, brushes having shafts journaled in said beam, adjusting-screws for vertically adjusting the beam, and mechanism for turning the brush-shafts in their bearings in the beam to angularly adjust the brushes, substantially as described.

18. In a furnace, the combination with a disk-shaped rotary hearth, of a circular arch supported beneath the hearth, a burner-pipe supported on the arch and provided with a gas-supply pipe, means for preventing the escape of heat and the products of combustion between the edges of the hearth and arch, and a discharge-chute surrounding the hearth and arch, substantially as described.

19. In a furnace, the combination with a disk-shaped rotary hearth, of a circular arch supported beneath the hearth, a burner-pipe supported on the arch and provided with a gas-supply pipe, means for preventing the escape of heat and the products of combustion between the edges of the hearth and arch, a discharge-chute surrounding the hearth and arch, and a cooling-chamber into which said chute discharges, substantially as described.

20. In a furnace, the combination with a disk-shaped rotary hearth, of a circular arch supported beneath the hearth, a burner-pipe supported on the arch and provided with a gas-supply pipe, means for preventing the escape of heat and the products of combustion between the edges of the hearth and arch, a discharge-chute surrounding the hearth and arch, a funnel-shaped cooling-chamber ar-

ranged beneath the arch into which the chute discharges, and a conveyer arranged beneath the lower end of the cooling-chamber, substantially as described.

21. In a furnace, the combination with a disk-shaped rotary hearth, of a circular arch supported beneath the hearth, a burner-pipe supported on the arch and provided with a gas-supply pipe, means for preventing the escape of heat and the products of combustion between the edges of the hearth and arch, a chute surrounding the hearth and arch, and a central downtake-flue extending down through the arch and communicating with a lateral offtake-flue leading outside the furnaces, substantially as described.

22. In a furnace, the combination with a disk-shaped rotary hearth, of a hopper arranged centrally above the hearth, a feed-regulator arranged in the hopper, a radial brush-support carrying brushes disposed over the hearth, means for adjusting said brushes, a circular arch supported beneath the hearth, a burner-pipe supported on the arch and provided with a gas-supply pipe, means for preventing the escape of heat and the products of combustion between the edges of the hearth and arch, a discharge-chute surrounding the hearth and arch, a funnel-shaped cooling-chamber arranged beneath the arch into which the chute discharges, and a conveyer beneath the lower end of the cooling-chamber, substantially as described.

23. In a furnace, the combination with a disk-shaped rotary hearth, of a circular arch supported beneath the hearth, a burner-pipe supported on the arch and provided with a gas-supply pipe, means for preventing the escape of heat and the products of combustion between the edges of the hearth and arch, a chute surrounding the hearth and arch, a central downtake-flue extending through the arch, a cooling-chamber into which the said chute discharges, a worm conveyer for carrying off the ore from the cooling-chamber, a hopper arranged over the hearth and provided with a feed-regulating device, and adjustable brushes disposed over the hearth, substantially as described.

In testimony whereof I have hereunto set my hand in presence of two subscribing witnesses.

JAMES P. CALNAN.

Witnesses:

F. W. LE PREVOST,
MARK A. WALSH.