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ROASTING FURNACE.
APPLICATION FILED FEB. 7, 1902. RENEWED JAN. 26, 1910.

Patented Aug. 23, 1910.

3 SHEETS—SHEET 1.

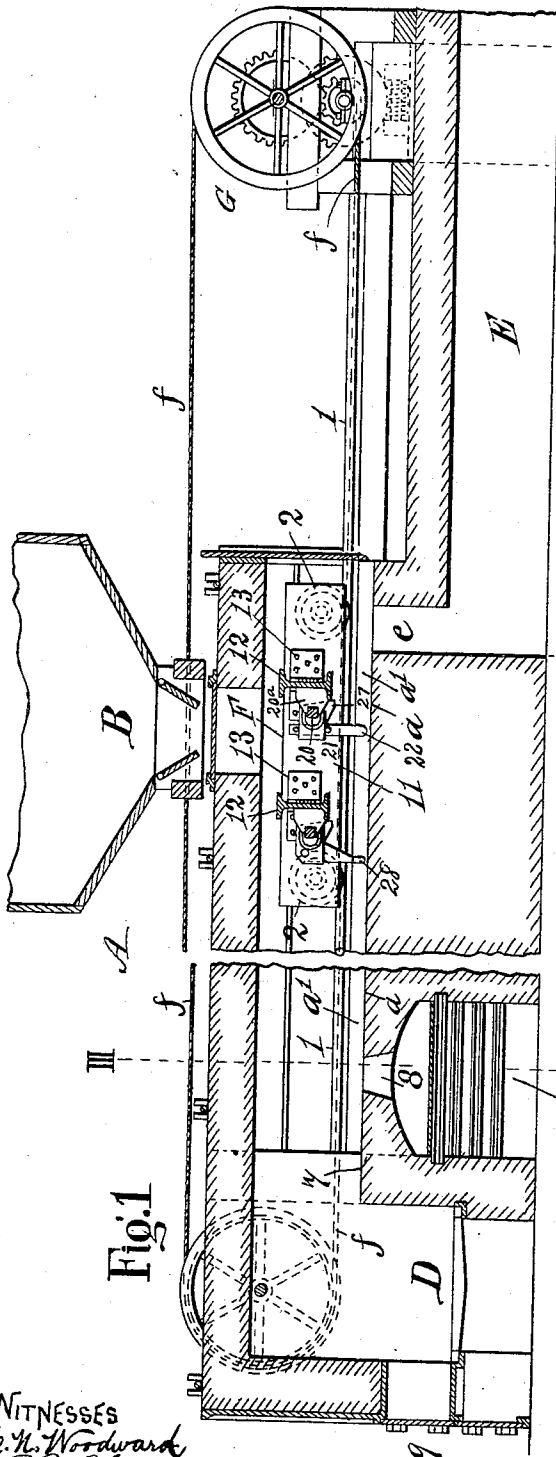


Fig. 1

WITNESSES
C. H. Woodward
C. P. Alexander

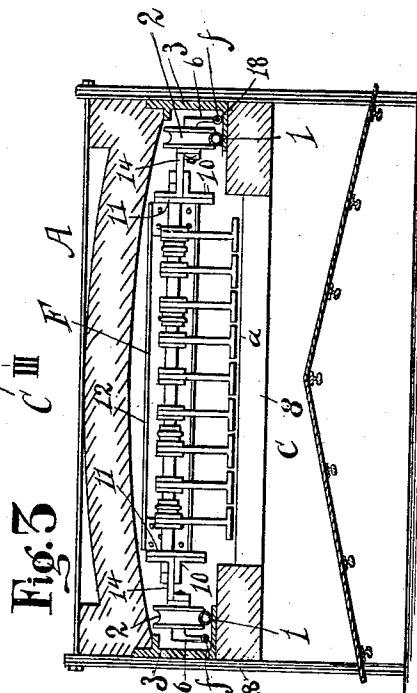


Fig. 3

CYRUS ROBINSON, INVENTOR.
BY A. H. Bliss ATTORNEY.

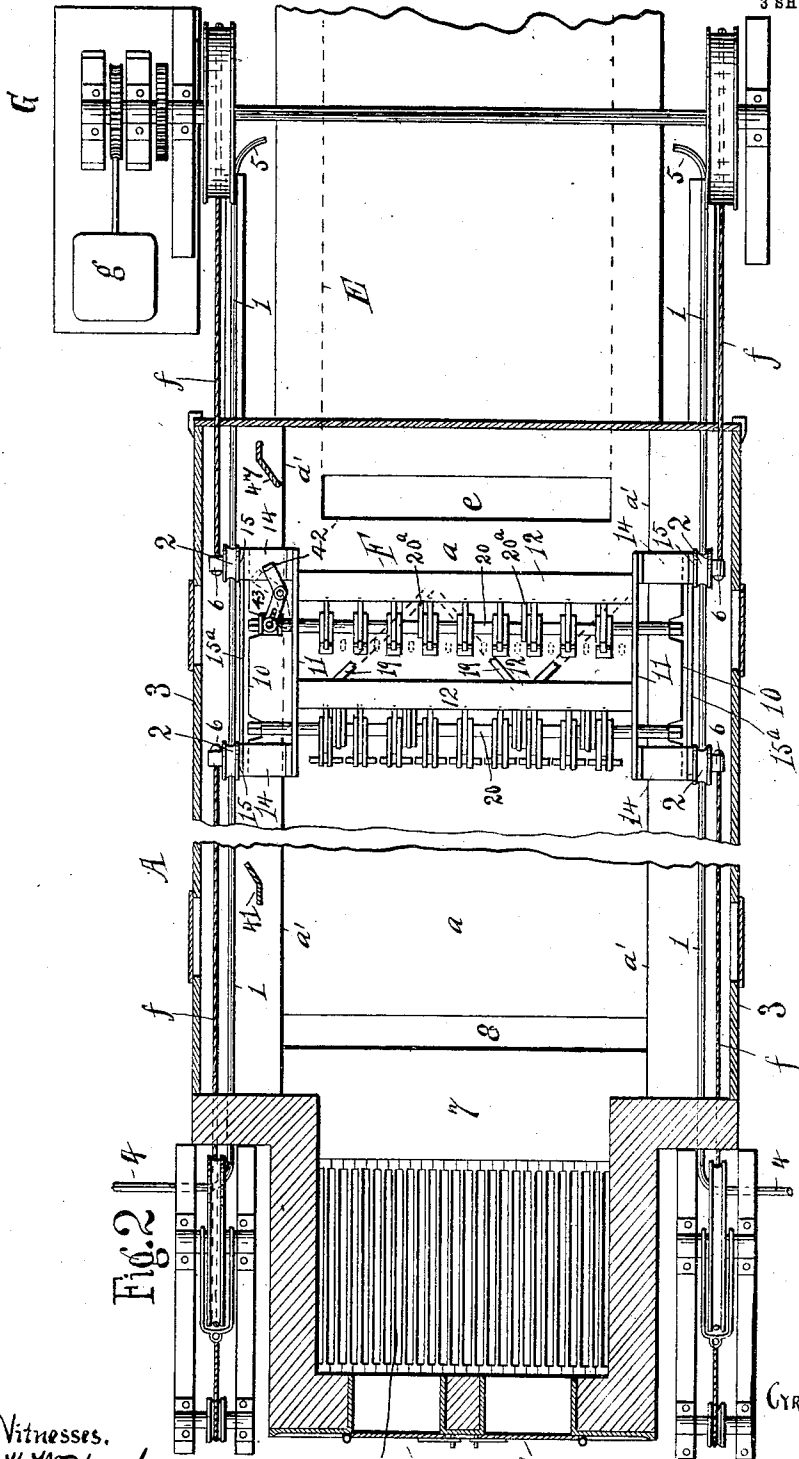
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3 SHEETS—SHEET 2.



Witnesses.
C. H. Woodward,
Ed. A. Alsdorf.

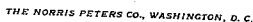
CYRUS ROBINSON,
Inventor.

By W. H. Bliss Attorney.

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3 SHEETS—SHEET 3.



UNITED STATES PATENT OFFICE.

CYRUS ROBINSON, OF NEW YORK, N. Y.

ROASTING-FURNACE.

968,265.

Specification of Letters Patent.

Patented Aug. 23, 1910.

Application filed February 7, 1902, Serial No. 93,075. Renewed January 26, 1910. Serial No. 540,271.

To all whom it may concern:

Be it known that I, CYRUS ROBINSON, a subject of the King of Great Britain, residing at New York, in the county of New York and State of New York, have invented certain new and useful Improvements in Roasting-Furnaces, of which the following is a specification, reference being had therein to the accompanying drawing.

10 This invention relates to roasting furnaces of that type in which the ore is mechanically stirred on the hearth of the roasting chamber by a carriage or rabble moved through the chamber by a suitable carrying or draft device, and consists in the parts and combinations thereof hereinafter set forth and claimed.

It will be understood that, while I have herein set forth the preferable and most efficient construction, for the purpose of fully illustrating the invention, my improvements may be usefully applied otherwise than in the exact construction which I now proceed to describe, in connection with the accompanying drawings.

25 In said drawings, Figure 1 is a longitudinal sectional view of a roasting furnace embodying my invention, the middle part of the furnace being broken away. Fig. 2 is a plan view of the same, partly in section. Fig. 3 is a transverse vertical section on the line III, Fig. 1. Fig. 4 is a similar section, on a larger scale, showing a portion of the roasting chamber and the stirring or conveying carriage or rabble. Fig. 5 is a plan view of one end of the rabble. Fig. 6 is a vertical section of the rabble on line VI, Fig. 5. Fig. 7 is a perspective view of a form of shaft or support suitable for carrying the ore engaging devices.

Referring to the drawings, A indicates the roasting furnace as a whole, having a relatively long and substantially horizontal roasting hearth, *a*, bounded at the sides by ore retaining shoulders or elevations, *a'*; B the feeding hopper for the ore or other material, which is to be understood as typical of any desired feeding means, the same being located at or near one end of the furnace, hereinafter referred to as the rear end; C the pit or receptacle below the hearth for receiving the roasted ore, and located at or near the other end of the furnace, herein referred to as the front end; D the heat generating furnace located at the front end of the roasting furnace and adapted to deliver

the products of combustion to and along the hearth *a*; E the exit flue for the products of combustion, having a suitable communication at *e* with the rear end of the roasting chamber and connected with a stack (not shown) or other suitable means for taking away the said products, with the fumes generated in the roasting chamber; F the ore stirring and conveying carriage or rabble mounted to traverse the roasting chamber longitudinally at will in either direction, actuated by cables or other draft devices, *f*; G the rabble actuating mechanism, comprising a motor, *g*, which may conveniently be of the electric type, for actuating the cables or draft devices.

Referring to the rabble in its general relation to the furnace, and to its constructions in detail, 1 indicates the supporting track rails or guides for the rabble wheels, 2, said rails being arranged on the hearth, *a*, longitudinally of and at each side of the roasting chamber, at or near the side walls 3 of the latter and a little within the outer limits of the hearth. Said guides are hollow and constitute conduits through which are circulated bodies of water by suitable fluid forcing means through supply pipes 4 and discharge pipes, 5. The water thus heated may be taken from the pipes 5, and usefully employed, as in steam generation, for the operation of the mechanical parts of the furnace.

At the outer sides of the guides, 1, are arranged the cables or draft devices *f* for the rabble, which may be conveniently wire ropes, secured to brackets or hangers, 6, depending from the rabble at its sides to a point sufficiently near the hearth to enable the water containing guides, 1, to protect the draft devices from the extreme heat of the central part of the roasting chamber.

The rabble is withdrawn from the roasting chamber at the end remote from the furnace, D, a space being left for that purpose, traversed by the guides, 1, between the rear end of the furnace and the actuating mechanism at G. At the front end of the furnace at 7, there is a space for the travel of the rabble between the furnace D and the ore receiving opening 8, through which the ore is discharged into the pit, C, of sufficient extent to allow the conveying device of the rabble to deliver the ore to said discharge. The rabble thus, in its travel, stops short of the heat generating furnace and enables the

latter to be conveniently fed from the top or otherwise through fire box doors, 9.

The main frame of the rabble carriage is formed of longitudinal L-bars 10 riveted or otherwise connected with longitudinal plates, 11, the latter of which carry transverse I-bars, 12, secured to said plates by brackets, 13.

Outwardly extending brackets 14 attached to the bars 10 carry the wheel spindles 15 by depending lugs 16. The spindles at each side of the carriage are connected by longitudinal bars 15^a, which act as braces and draft bars. At the outer side of the wheel 2, mounted on said spindle, is the depending arm or hanger 6, forming the means for the attachment of the draft device, *f*, at 18, and carrying said device at a relatively low point behind or at the outer side of the water containing guide, 1.

The rabble carriage is stiffened by braces 19 secured to the horizontal flanges of the bars 12. 20 is a transverse bar carried by the longitudinal bars of the carriage in supports 20^a and supporting at intervals the individually movable stirrers, 21. The latter are provided with one or more stirring fingers, 22 and each at its upper end has an eye 23 encircling the bar 20. I prefer to make the eye piece of U-shape and extend it in a substantially horizontal direction from the bar 20, making the finger 22 separate from the eye piece and supporting it in the bend of the latter where it is secured in a substantially vertical position by means of pins, 24, so that its lower end may traverse the hearth, *a*, and agitate the ore.

25 is a stop plate, encircling the bar, 20, between the arms of the finger carrier, 23, and engaging the vertical side of the finger by a flat surface, 26, so as to be movable on the bar 20 with the finger. Said stop plate has an extension or arm 27, adapted to rest against one of the beams 12 so as to hold the finger from turning when the rabble is moving toward the discharge 8 and keep the finger in engagement with the hearth and the ores. When, however, the rabble is traveling in the other direction, it may turn, with the part, 23, if it encounters any material obstruction and is thus adapted to lift and ride over any solid accretion on the hearth.

The conveying means carried by the rabble comprises hoes 28 individually movable on the backward movement of the carriage so as to drag over the ore without materially moving it, and on the forward movement to be held with sufficient rigidity to convey the ore toward the discharge 8. The hoes have further a movement similar to that of the stirring fingers, enabling them during their conveying or forward movement to lift or ride over strongly resisting obstructions or accretions. For these purposes the hoe

has an arm 29 hung on a transverse pivot 30 in the outer or front ends of the eye pieces, 31, the other ends of which encircle a bar, 32. This bar extends across the carriage and is held in supports 33 on the other beam 12. Between the pieces 31 is fitted a stop arm 35 embracing the bar 32, abutting at its front side the rear of the arm 29 and at its rear end engaging the beam 34. The upper end of the arm 29 is concentric with the pivot 30, as shown at 36. As the hoe is carried rearward away from the discharge 8, it may turn on the pivot 30 and drag over the ore, the rounded end 36 permitting such turning. When moved in the opposite direction the resistance of the ore to the hoe causes the arm 30 to press against the front of the stop 35, which holds the hoe in conveying position to carry the roasted ore to the discharge 8. When, however, a solid obstruction is encountered by any hoe, the other hoes are not interfered with, but the hoe in question may lift, the parts 30, 31, 35 turning together on the bar 32. The hoes are held spaced apart on said bar by pins 37 inserted in the latter at the sides of the pieces, 31. The supports 33 may effect the same spacing function when they are situated immediately at the sides of said pieces. The stirrers are similarly held in position laterally by pins 38 in the bar 20.

It will be understood that the bars 20 and 32 may be arranged to turn in the supports, 20^a and 33, the stirrers and hoes being so mounted on said bars as to be lifted, by such turning, away from the hearth. Said mounting may be by making the parts of said bars, 20, 32, where the pieces 25 and 35 are situated, square or angular in cross section. The turning of the bars, 20, 32 may be effected by applying a key to the squared ends 40 of said bars when the rabble is withdrawn from the furnace. Or the said bars may be fixed and the hoes and stirrers turned up one by one into inoperative position, resting against the upper parts of the beams, 12. The ore treating parts of the rabble may thus be adjusted for the desired operation on the ore.

Various means may be employed for changing the direction of movement of the ropes *f* and the rabble, such as a reversing clutch in the mechanism *G*, or a reversal of the motor.

For allowing the hoe carrying devices to turn up freely on meeting obstructions, as already described, and for also adjusting them up positively, the pieces 31 are mounted on round parts of the bar or shaft 32 while the stop 35 is on a squared part of said bar. The hoes when down may thus lift as required, while a turning of the bar 32 by its end 40 will carry the stops 35 down and forward against the hoe arms 29 to lift all the hoes simultaneously from the hearth.

Where the rabble proceeds forward and backward constantly with the stirring fingers in the same longitudinal vertical planes, there will be a more or less imperfect stirring or agitation of the ore; that is to say there will be left longitudinal ridges of ore between the paths of the stirring fingers. To obtain a complete stirring of all the ore I provide for a lateral shifting of the stirring fingers at proper times, causing them to take one path on their forward motion and another path on their rearward movement. Thus the ridges of ore left at one movement are plowed by the fingers on the return movement and distributed. I have illustrated a convenient means for giving the rabble fingers the required change of position for this operation, consisting of a stop or cam 41 located at or near the end of the inward movement of the rabble, which is encountered by a projection 42 on the rabble. Said projection is a part of a lever 43 pivoted to a portion of the rabble carriage at 44 and engaging a collar 45 on the shaft which carries the stirring fingers. The collar 45 is loose and is confined between the fixed collars 46 on said shaft. This construction allows the shaft to be turned to throw the stirrers out of operation, and will shift the shaft laterally, carrying the stirring fingers to new positions of operation, when the stop 41 is encountered. I prefer to arrange a similar stop at or near the outer end of the furnace and within the roasting chamber, as shown at 47. The backward and forward shifting of the stirring fingers is thus made automatic during the operation of the rabble within the roasting chamber.

An illustrative operation of the furnace may be described as follows: For a period of about two hours the ore which has been fed to the roasting chamber is stirred by the fingers 22, in the manner above described, the hoes 28 being turned up out of the way, the hoe carrying shaft having been turned by a wrench for that purpose, and a pin 60 (Fig. 4) having been inserted to hold the shaft in the position where the hoes are at right angles to their operating position. About every fifteen minutes the carriage is sent into the furnace and comes out, traveling at a speed of about forty feet per minute, and remaining out of the furnace for about thirteen minutes during which latter time the carriage is allowed to cool. This ability to rabble the ore at will and as often as seen desirable, according to the class of ore being roasted, is highly important. At the end of about two hours the hoes are turned down into the operative position and about ten feet of the inner part of the hearth is scraped clean into the discharge hopper 8, and the next ten feet of ore is moved forward into the portion of the hearth vacated,

and so on, until the whole contents of the hearth is moved forward in sections and a new supply taken in from the feeding device. Then the hoes are turned out of operative position again by turning their shaft, and the rabbling fingers are passed forward and backward over the hearth to distribute and thin out and agitate the piles of ore left by the hoes or scrapers.

By the use of my invention I am enabled to sinter or partly slag the material at the inner part of the hearth, making it stick together by partly reducing the lead and silica, and remove it into the discharge as above described only when aggregated in pieces sufficiently large to be put into the smelting furnace. I thus avoid the expense of briquetting which is ordinarily necessary with finely divided or leady ores, which, by the ordinary roasting furnace are discharged, oxidized, in about the same physical condition in which they enter the roasting furnace; that is, in the form of fine crushed ore which must be briquetted at considerable expense before going into the smelting furnace.

Heretofore it has generally been the practice when mechanical rabbles of the earlier sort have been used, to so construct and arrange the parts that whatever action upon the ore is commenced and effected at one end of the hearth must be carried on uniformly to the other end at each traverse of the rabbles. These earlier mechanical rabbles have each been mechanical throughout the structure, and driven by the power under fixed conditions, and so arranged as to be beyond the optional control of the operator. As a result, and as is well known, furnaces with mechanical rabbles have never been found to be equal (with respect to the superiority of the roasting) to those where hand rabbling was practiced. The said earlier mechanical rabbling devices act automatically and continuously, each finger or arm stirring and advancing the material with uniformity and continuity from one end of the hearth to the other at each traverse. But it is well known that some ores, at certain stages of the roasting, require longer heating than other ores, and at other stages require less heating.

Again, it is well known that it is desirable to have ores of many sorts "sintered," in the way above described, prior to their final delivery from the roasting hearth. When hand rabbling is practiced, such sintering is attainable and there is a consequent economy in the later reduction and treatment of the material, as above described. This, and other desirable results referred to, demand that the ore (after it has been exposed to the heat during the preceding stages of treatment upon the several preliminary sections of the hearth) should remain at rest

for a comparatively long period of time upon the final hearth section. This prolonged resting of the material, and the sintering referred to, are interfered with, in fact are practically thwarted by the earlier mechanical rabbles, because of the above described action necessarily incident to them; that is because of their acting uniformly upon the ore from one end of the hearth to the other at each traverse. This will be readily understood when the following facts are remembered. The ore undergoes two clearly distinguishable actions while on the hearth. One is the agitating, stirring and distributing thereof. The other is the advancing thereof longitudinally of the hearth.

Now, the earlier mechanical rabbles have, so far as I am aware, all been aimed to accomplish both of these results simultaneously. They comprise ore engaging devices, of one form or another, such that they were not only expected to effect the stirring of the ore, but also (at each action of stirring or agitating each particle) to simultaneously advance it somewhat. Sometimes use has been made of rectilinearly reciprocating, vertically arranged or engaging bars, triangular in horizontal section, each having the apex of its prism situated toward the receiving end of the hearth and the base part toward the discharge end of the hearth, and lying in a transverse plane; and in such cases as the arms move toward the receiving end of the hearth they tend to plow through or turn up the ore, and when moving through the return part of their reciprocation the flat front surfaces act to push a quantum of the ore mass along toward the discharge end. And at each reciprocation of the rabble these ore engaging arms travel first from the discharge end to the receiving end and then on reversal travel continuously from the receiving end to the discharge end. Quantities of the ore are delivered finally at each reciprocation of the rabble. The ore is moved over the final hearth section just as rapidly as over any of the preceding sections. But with the present mechanism, the two functions or actions upon the ore can be separated as widely as possible. The agitating of the ore in my case can be an action quite separate from the advancing of it. The rabbling or agitating fingers 22, being very narrow in transverse dimensions, merely move through the ore layer on longitudinal lines, acting to expose new particles without pushing them forward, and consequently the extent to which the treatment is carried during each of the different successive periods of time can be accurately controlled and regulated. Then when the action of advancing is to be attained, it can be done separately from the agitating and

accomplished quickly by bringing into operation the conveyer hoers which are constructed materially differently from the agitating fingers.

Of course, it will be understood that all of the novel features are not to be limited to the mode of operation just described, although it is the preferred manner of operating the apparatus. And it will be further understood that in numerous respects there can be modifications of the parts of the apparatus without departing from the essential features of the invention.

What I claim is:

1. In an ore roasting furnace, the combination of the hearth, a rabble reciprocating and operating thereon, draft devices for reciprocating the rabble, a heat generating furnace at and beyond one end of the hearth, an actuating mechanism for said draft devices situated at and beyond the other end of the furnace, guides for the rabble on the hearth extending beyond the latter toward said mechanism, and means for the escape of the products of combustion at the said other end of the furnace.

2. In an ore roasting furnace, the combination of a roasting hearth, a rabble operating thereon, a heat generating furnace at the front end of said hearth, an actuating mechanism for the rabble situated at and beyond the rear end of the hearth, leaving a space for withdrawing the rabble from the hearth, and a flue leading longitudinally rearward from the rear end of the hearth past and below said space.

3. In an ore roasting furnace, the combination of a roasting hearth, a rabble operating thereon and provided with ore-conveying means adapted to be moved on the rabble out of operative position, a heat generating furnace at the front end of the hearth, an actuating mechanism at and beyond the rear end of the hearth, leaving a space for withdrawing the rabble from the hearth and allowing the adjustment of said ore conveying means, and a flue leading from the rear end of the hearth past and below said space.

4. In an ore roasting furnace, the combination of the hearth, a rabble operative thereon having ore stirring means and ore conveying means, the latter being adjustable into operative or inoperative position, and means for advancing and for reversing at will the direction of movement of the rabble to operate exclusively on a desired section of the hearth, substantially as set forth.

5. In an ore roasting furnace, the combination of a hearth, a rabble operating thereon, hollow guides or rails for the rabble adapted to contain liquid, and draft devices for the rabble extending near said guides along the hearth and below the tops of said guides.

6. In an ore roasting furnace, the combination of a hearth, a rabble operating thereon, hollow guides or rails for the rabble adapted to contain liquid, and draft devices, 5
f, connected with the rabble and extending along the outer sides of said guides.

7. In an ore roasting furnace, the combination of a hearth having at its sides the elevations, a', and hollow imperforate guides 10
or rails for the rabble adapted to contain liquid and mounted and fixed on said elevations.

8. In an ore roasting furnace, the combination of a hearth, a rabble movable 15
thereon in either direction at will, mechanism for actuating the rabble having a reversing means, and ore treating devices on the rabble having a free automatic up and 20
down movement on the latter while in operative position, and adjustable into operative or inoperative position.

9. In an ore roasting furnace, the combination of a hearth, a rabble movable 25
thereon in either direction, a supporting means for the rabble outside the roasting chamber, means for actuating the rabble in either direction in said chamber and withdrawing it therefrom on to said supporting 30
means, and ore treating devices on the rabble adjustable into operative and inoperative position.

10. In an ore roasting furnace, the combination of a hearth, a rabble movable 35
thereon in either direction, a supporting means for the rabble outside the roasting chamber, means for actuating the rabble in either direction in said chamber and withdrawing it therefrom on said supporting means, and 40
hoes on the rabble individually movable to lift over obstructions and adjustable into operative or inoperative position.

11. In a roasting furnace, the combination of a hearth, a rabble and ore conveying 45
devices on the rabble having two independent movements, the conveying devices being independently movable up and down to ride over obstructions, and having pivots on 50
which they may turn to drag over the ore without conveying action.

12. In a roasting furnace the combination of a hearth, a rabble movable 55
thereon in either direction, a transverse supporting bar on said rabble, longitudinally extending hoe-carrying arms or pieces mounted to turn on said bar, hoes having upwardly extending 60
arms having pivotal connections with said hoe carrying arms, and stops holding the hoes from rearward movement.

13. In an ore roasting furnace, the combination of a roasting hearth, a rabble operating 65
thereon, supporting wheels for the rabble, means for reciprocating the rabble on said hearth and devices for laterally shifting relative to said wheels the ore stirring portions of the rabble.

14. In an ore roasting furnace, the combination of a hearth, a rabble operating 70
thereon having conveying means and stirring fingers, independent of said conveying means, said conveying means being adjustable into inoperative position, and mechanism 75
for laterally shifting said stirring fingers.

15. In an ore roasting furnace the combination of a roasting hearth, a rabble operating 80
thereon having a laterally movable shaft or support, stirring fingers on said support, means for reciprocating the rabble on the hearth, a stop or cam at each end of the path of the rabble, and means whereby 85
said stops are caused to laterally move said shaft, substantially as set forth.

16. In an ore roaster, the combination of a roasting hearth, a rabble carriage transferable to different parts of said hearth to 85
treat the ore on one part of the hearth independently of that on other parts of the hearth, a series extending from side to side of the hearth of individually movable stirring 90
fingers, each pivotally and individually connected with the carriage, and means for transferring the rabble from one part of the hearth to another and for operating the same on the latter part of the hearth exclusively. 95

17. In an ore roaster, the combination of a roasting hearth, a rabble carrier and rabble having ore stirring and ore conveying 100
means, and power devices for advancing said rabble and for operating it at will on a desired limited section of said hearth, whereby a portion of the ore may be agitated or may be delivered in roasted condition while the material on all other sections of the hearth 105
remains undisturbed.

18. In an ore roaster, an ore treating rabble having a series of stirrers pivotally 110
mounted and individually movable, and means connected with several of said stirrers for moving them together into an inoperative position.

19. In an ore roaster, an ore treating rabble consisting of a movable carriage, a bar or shaft transversely movable in said carriage, a series of stirrers mounted on said 115
shaft, and means for moving said shaft longitudinally in the carriage to shift the positions of said stirrers.

20. In an ore roaster, an ore treating rabble having a series of arms pivotally 120
mounted independently of each other and individually movable toward and from the hearth and stirring fingers separate from and carried by said arms.

21. In an ore roasting furnace, an ore 125
treating rabble having a series of stirrers, and a series of scrapers, and hand operated means for moving each of said devices at will into inoperative position.

22. In an ore roaster, a rabble having a 130

series of ore engaging and moving devices, and means for shifting said devices at will into inoperative position independent of the movement of the rabble.

23. In an ore roaster, an ore treating rabble consisting of a movable carriage and ore-engaging devices each pivotally mounted thereon to swing about two parallel transverse axes.

24. In an ore roaster, an ore treating rabble consisting of a movable carriage having a transverse series of individually movable conveying flights or scrapers, the whole forming a transverse substantially continuous ore conveyer, all of the flights of said series being adapted to be held out of action when the carriage is in operative position.

25. In an ore roaster, the ore treating rabble consisting of the movable carriage, a plurality of ore conveying scrapers pivotally mounted on the carriage and freely movable in vertical planes, the operative edge of each scraper being out of the transverse vertical plane of its pivot and in advance thereof, whereby each scraper will operate to advance the material on the hearth when traveling in one direction and will ride freely over it when traveling in the other direction and means for simultaneously moving said scrapers into and out of operative position.

26. In a roasting furnace, the combination of a hearth, a rabble operating thereon having ore stirrers, and having ore conveying means separate from said stirrers, and means for causing the operation of said stirrers or of said scrapers at will independent of the movement of the rabble, substantially as set forth.

27. In an ore roasting furnace, the combination of the hearth, an ore treating rabble operative thereon having means for engaging the ore on said hearth, said rabble being transferable to different parts of said hearth to treat the ore on one part of the hearth independently of that on other parts of the hearth, and means for causing the operation of the rabble at will on a limited portion of the hearth, substantially as set forth.

28. In an ore roaster, a rabble having a series of conveying scrapers individually movable relatively to each other toward and from the hearth, means connected with said scrapers for moving them together into inoperative position, a series of stirrers on said rabble individually movable relative to each other, and means connected with the stirrers for moving or shifting them as a whole, substantially as set forth.

29. In an ore roasting furnace, the combination of the hearth, an ore stirring rabble operating thereon, and means for reversing at will the direction of movement of the rabble to operate exclusively on a limited sec-

tion of the hearth, without disturbing the ore on other portions of the hearth, substantially as set forth.

30. In an ore roasting furnace, the combination of the hearth, an ore stirring rabble operating thereon, a flexible cable connected with the rabble for actuating the same, and hand operated means for causing at will the operation of the rabble on a limited section of the hearth the ore on other portions of the hearth being left undisturbed, substantially as set forth.

31. In an ore roasting furnace, the combination of the hearth, a reciprocating rabble operating thereon, a rabble receiving support outside of the furnace, a door permitting the passage of the rabble and adapted to separate said support from the furnace, and means for reversing the movement of the rabble and for leaving it stationary at will on said support, substantially as set forth.

32. The combination of the roasting hearth elongated to provide a series of sections in line with each other, on which respectively, the material can be subjected to steps of treatment differing from each other; of propelling mechanism, two sets of ore engaging devices adapted to be carried along the hearth by the propelling mechanism, the ore engaging parts of one set being relatively thin on lines transverse of the hearth, whereby they stir the ore without advancing it, and the ore engaging parts of the other set being relatively wide on said transverse lines, whereby they are adapted to advance bodies of ore in contradistinction from merely stirring them, and the devices of the second aforesaid set being adjustable to an inoperative position and the inclosing walls above the hearth provided with passages permitting access at each of several points to the said ore engaging devices, substantially as set forth.

33. The combination of the roasting hearth elongated to provide a series of sections in line with each other, on which respectively, the material can be subjected to steps of treatment differing from each other; of propelling mechanism, two sets of ore engaging devices adapted to be carried along the hearth by the propelling mechanism, the ore engaging parts of one set being relatively thin on lines transverse of the hearth whereby they stir the ore without advancing it, and the ore engaging parts of the other set being relatively wide on said transverse lines and adapted to form a scraping device extending substantially continuously across the hearth, whereby they are adapted to quickly advance bodies of ore, means for holding the devices of the second set in inoperative position while they are being bodily moved and the inclosing walls above the hearth provided with passages permitting access at each of several points to the said

ore engaging devices to put them into and out of operative positions, substantially as set forth.

34. The combination of the roasting hearth
5 elongated to provide a series of sections in line with each other on which respectively the material can be subjected to steps of treatment differing from each other, of the propelling mechanism, a carriage or support
10 connected therewith and propelled thereby, and two sets of ore engaging devices supported in common by the said carriage, those of one set being relatively thin on lines transverse of the hearth and those of the
15 other set having relatively wide ore engaging parts adapted to form a substantially continuous transverse scraper for advancing the ore in contradistinction to stirring it, means for holding the last said ore engaging
20 devices in inoperative position while the carriage is moving along the hearth and the inclosing walls above the hearth provided with passages permitting access at each of several points to the said ore engaging devices
25 to put them into or out of operative positions, substantially as set forth.

35. In an ore roasting mechanism, the combination with a roasting hearth arranged to receive the ore at one end and discharge
30 it at the other, of a propelling mechanism, ore stirring devices propelled thereby and adapted to act upon the ore in the same manner in whichever direction they are moving longitudinally of the hearth, and means
35 for automatically moving the said stirring devices laterally from one set of longitudinal paths when moving in one direction to another set of longitudinal paths when moving in the opposite direction, substantially as set
40 forth.

36. In an ore roasting mechanism, the combination with a roasting hearth, of the propelling mechanism, the set of ore stirring
45 devices propelled thereby longitudinally of the hearth and shaped substantially as set forth to be relatively thin on lines transverse of the hearth and adapted to stir the ore when moving in either direction without
50 advancing it, devices for moving the stirring devices laterally from one set of longitudinal paths to another set of paths, and a set of adjustable ore conveying blades or plates connected to the propelling mechanism and adapted to scrape or clean the
55 hearth in contradistinction from stirring the ore, substantially as set forth.

37. In an ore roasting furnace, the combination with a roasting hearth, of propelling mechanism, a set of ore-engaging
60 devices adapted to be carried along the hearth by the said propelling mechanism, each ore-engaging device of said set being relatively thin on lines transverse to the hearth whereby it stirs the ore without
65 advancing it, and means for causing the said

ore-engaging devices to operate on the ore on any desired portion of the hearth and to leave undisturbed the ore on the remaining portion of the hearth.

38. In an ore roasting furnace, the combination with the roasting hearth, of propelling mechanism, a set of ore engaging
70 devices adapted to be carried along the hearth by the said propelling mechanism, each ore engaging device of said set being relatively thin on lines transverse to the hearth whereby it stirs the ore without
75 advancing it, means for effecting the moving of said set of ore engaging devices into and out of operative position along certain portions of the hearth, and means adapted intermittently to change the longitudinal
80 line of travel of each of said ore engaging devices, along the hearth.

39. In an ore roasting furnace, the combination with the roasting hearth, of propelling mechanism, a set of ore engaging
85 devices adapted to be carried along the hearth by the said propelling mechanism, each ore engaging device of said set being relatively thin on lines transverse to the hearth whereby it stirs the ore without
90 advancing it, means for effecting the moving of said set of ore engaging devices into and out of operative position along various portions of the hearth, a second set of ore
95 engaging devices adapted to advance bodies of ore in contradistinction to merely stirring them, and means for effecting the adjusting said second set of ore engaging
100 devices into and out of operative relation with various portions of the hearth.

40. In an ore roasting furnace, the combination with the roasting hearth, of propelling mechanism, a set of ore engaging
105 devices adapted to be carried along the hearth by the said propelling mechanism, each device of said set being adapted to advance the material with which it engages when in operative position along the hearth,
110 and means for effecting the moving of said set of ore engaging devices into and out of operative relation with various portions of the hearth.

41. In an ore roaster, the combination of a rabble having a series of ore engaging
115 devices movable to vary their position on a line transverse to the hearth, and means for automatically moving said ore engaging devices into different positions along said
120 transverse line.

42. In an ore roaster, an ore treating rabble having a series of ore engaging
125 devices movable to vary their positions transversely on the hearth.

43. In an ore roaster, a rabble having a series of ore engaging devices laterally movable to vary their positions upon the hearth.

44. In an ore roaster, a rabble having a transverse shaft, a series of supporting
130

pieces carried by said shaft, and a series of ore engaging devices pivotally connected to said supporting pieces.

45. In an ore roaster, a rabble having a transverse shaft, a series of supporting pieces carried by said shaft, a series of ore engaging devices pivotally connected to said supporting pieces, and a series of positive stops for limiting the travel of said ore engaging devices about their pivots in one direction.

46. In an ore roaster, an ore treating rabble consisting of a movable carriage, and an ore conveying scraper pivotally mounted thereon to swing about two parallel transverse axes.

47. In an ore roaster, an ore treating rabble consisting of a movable carriage, an ore conveying scraper pivotally mounted thereon to swing about two parallel transverse axes, and a positive stop for limiting the movement of said scraper about one of said axes.

48. In an ore roasting furnace, the combination with the roasting hearth, of propelling mechanism, a set of ore-engaging devices adapted to be carried along the hearth by the said propelling mechanism, and means for causing the operation of said stirring devices along any portion of the hearth desired and for leaving the ore along the other portions of the hearth undisturbed.

49. In an ore roasting furnace, the combination with the roasting hearth, a propelling mechanism and a set of ore-engaging devices adapted to be carried along the hearth by the said propelling mechanism, each ore-engaging device of said set being relatively thin on lines transverse to the hearth, whereby it stirs the ore without advancing it, of means for effecting the operation of said set of stirring devices along any portion of the hearth desired, and means adapted intermittently to change the longitudinal line of travel along the hearth or each of said ore-engaging devices.

50. In an ore roasting furnace, the combination with a roasting hearth, of propelling mechanism, a set of ore-engaging devices adapted to be carried along the hearth by the said propelling mechanism, each device of said set being adapted to advance the material with which it engages when in operation along the hearth, and means for causing the operation of said ore-engaging devices along any desired portion of the hearth and for leaving the ore along the remainder of the hearth undisturbed.

51. In an ore roasting furnace, the combination with a roasting hearth, of propelling mechanism, a set of ore-engaging devices adapted to be carried along the hearth by the said propelling mechanism, each ore-engaging device of said set being relatively thin on lines transverse to the hearth, where-

by it stirs the ore without advancing it, a second set of ore-engaging devices adapted to advance bodies of ore along said hearth in contradistinction to merely stirring them, and means for causing the operation of said sets of ore-engaging devices along any desired portion of the hearth and for leaving undisturbed the ore along the remainder of the hearth.

52. In an ore roasting furnace, the combination with a roasting hearth, of propelling mechanism, a set of ore-engaging devices adapted to be carried along the hearth by the said propelling mechanism; and means for controlling said propelling mechanism so as to effect the travel of said ore-engaging devices forward and back along any desired portion of the hearth without disturbing the ore along the remainder of the hearth.

53. In an ore roasting furnace, the combination of a hearth, a rabble operative thereon having ore-stirring and ore-conveying means both of which are adjustable into and out of operative position, and means for advancing and reversing at will the direction of movement of the rabble to cause it to operate over various portions of the hearth.

54. In an ore roasting furnace, the combination of a hearth, a rabble operative thereon and having ore-stirring and ore-conveying means both of which are adjustable into and out of operative position, means for causing the rabble to travel along the hearth, and means applicable at will to cause either the said stirring means or the said conveying means to operate only on various portions of the hearth.

55. In an ore roasting furnace, the combination of a hearth, a rabble operative thereon and having ore-stirring and ore-conveying means both of which are adjustable into and out of operative position, means for causing the rabble to travel along the hearth, and means adapted to throw either the said stirring or the said conveying means into or out of operation along various portions of the hearth.

56. In an ore roasting furnace, the combination of a hearth, a rabble movable thereon in either direction at will, means for actuating the rabble having a reversing means adapted to be adjusted to cause the rabble to travel forward and back over any desired portion of the hearth, and ore-treating devices on the rabble adjustable at the will of the operator into operative or inoperative position.

57. In an ore roasting furnace, the combination of a hearth, a rabble movable thereon in either direction at will, means for actuating the rabble having a reversing means adapted to be adjusted to cause the rabble to travel forward and back over any desired portion of the hearth, ore-treating devices

on the rabble adjustable into operative or inoperative position, and means applicable at will, at various points along the hearth, to throw the said ore-treating devices into operative or inoperative position.

58. In an ore roasting furnace, the combination with a hearth, a rabble adapted to operate therealong, having conveying means adjustable into operative or inoperative position and stirring fingers independent of said conveying means and adjustable into operative and inoperative position, and mechanism for laterally shifting said stirring fingers.

59. In an ore roasting furnace, the combination of a hearth, a rabble adapted to travel therealong, ore-treating devices carried by said rabble and adjustable into operative or inoperative position relative to the hearth, means for causing the travel of the rabble, and means for throwing said ore-

treating devices into or out of operative position at will at various points along said hearth.

60. In an ore roasting furnace, the combination of a hearth, an ore-treating rabble operative thereon and carrying both ore-stirring and ore-conveying means, said rabble being transferable to different parts of said hearth to either stir or convey the ore on part of the hearth without disturbing the ore on the other part of the hearth, and means for causing the operation of the rabble at will on any desired portion of the hearth.

In testimony whereof I affix my signature in presence of two witnesses.

CYRUS ROBINSON.

Witnesses:

KARL EILERS,

H. W. ROBINSON.