

No. 640,058.

Patented Dec. 26, 1899.

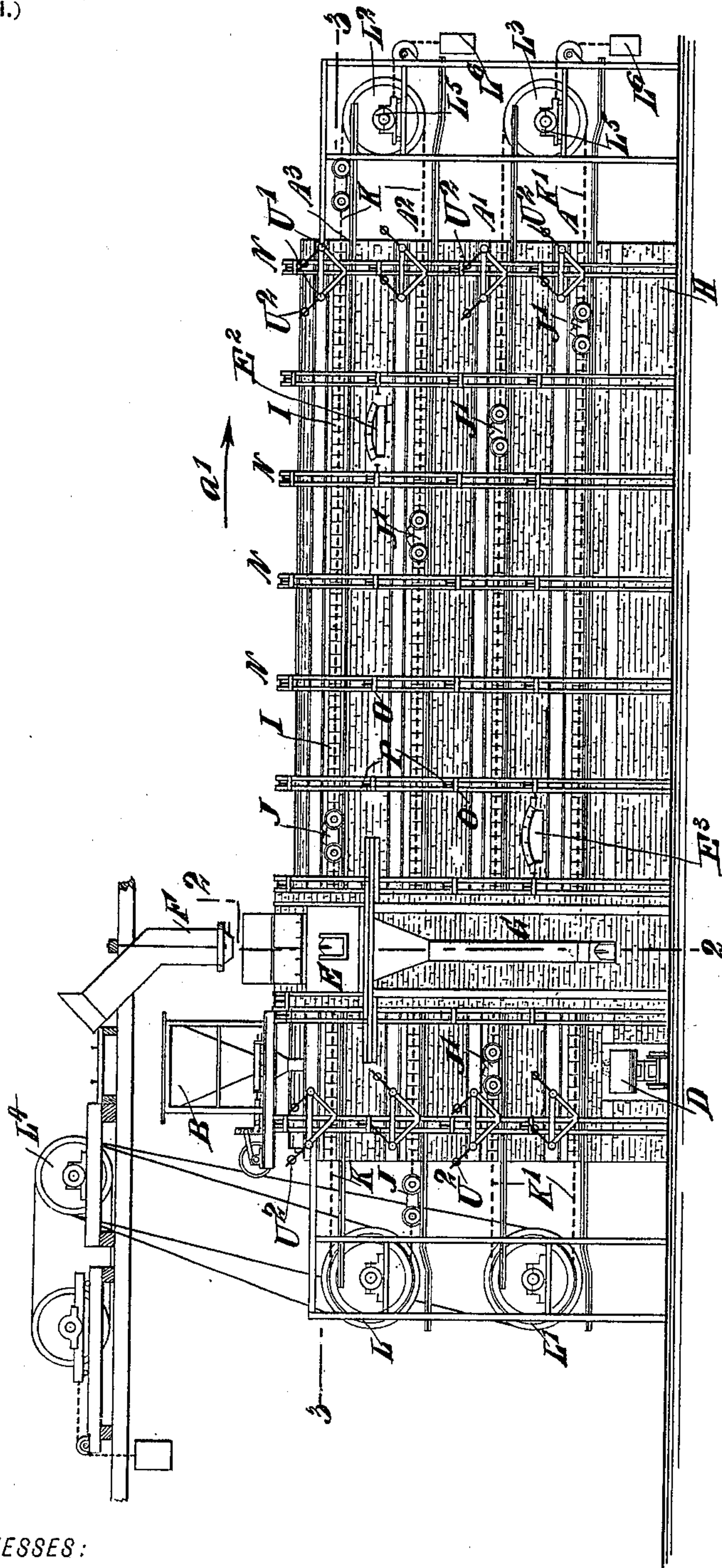
A. H. WETHEY.
CALCINING FURNACE.

(Application filed Jan. 24, 1896.)

(No Model.)

4 Sheets—Sheet 1.

Fig. 1



WITNESSES:

J. B. Walker
Rev. G. Root

INVENTOR

A. H. Wethey

BY

Wm. J. Root

ATTORNEYS.

No. 640,058.

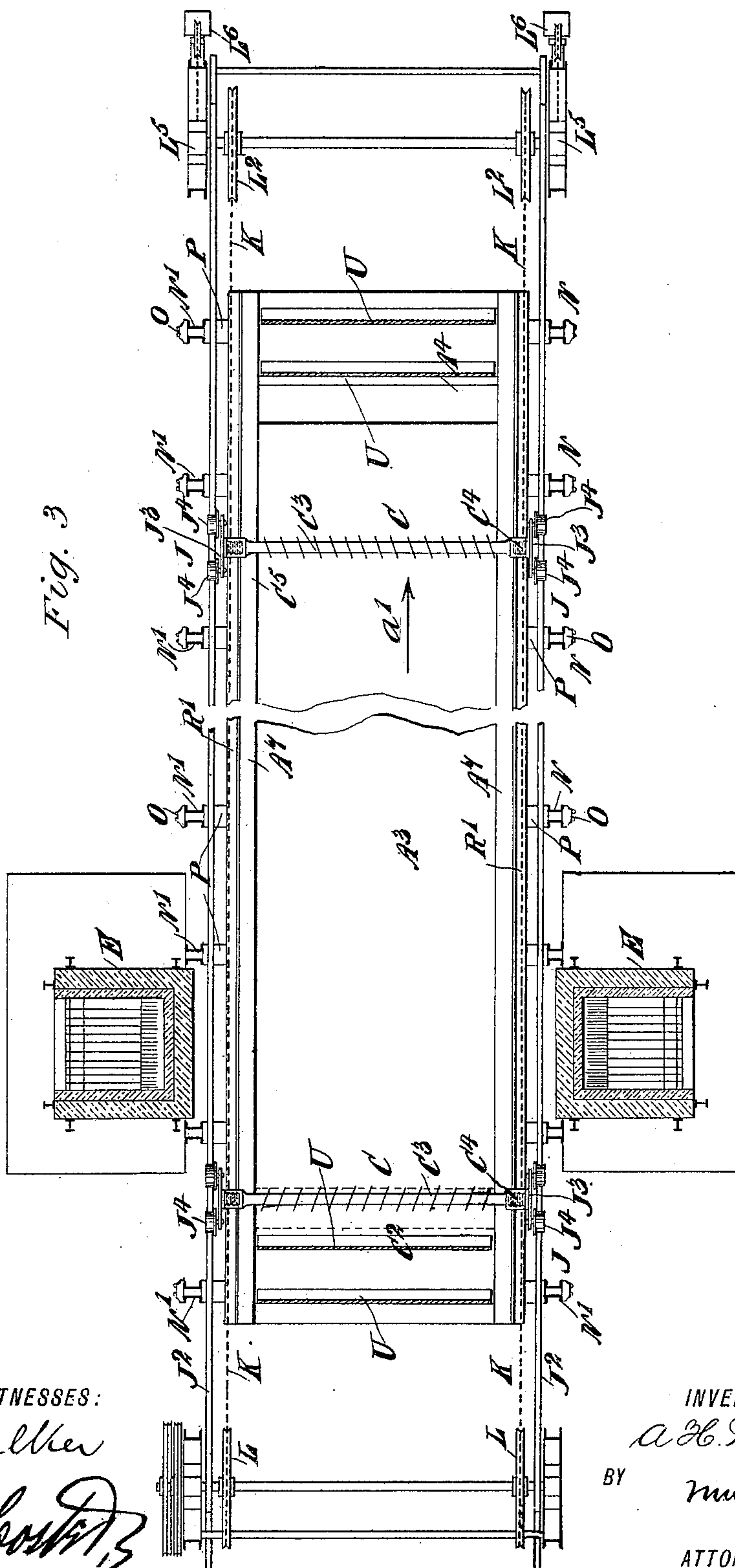
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4 Sheets—Sheet 3.



WITNESSES:

J. B. Walker
N. G. Hoadley

INVENTOR

A. H. Wethey

BY

Munn

ATTORNEYS.

No. 640,058.

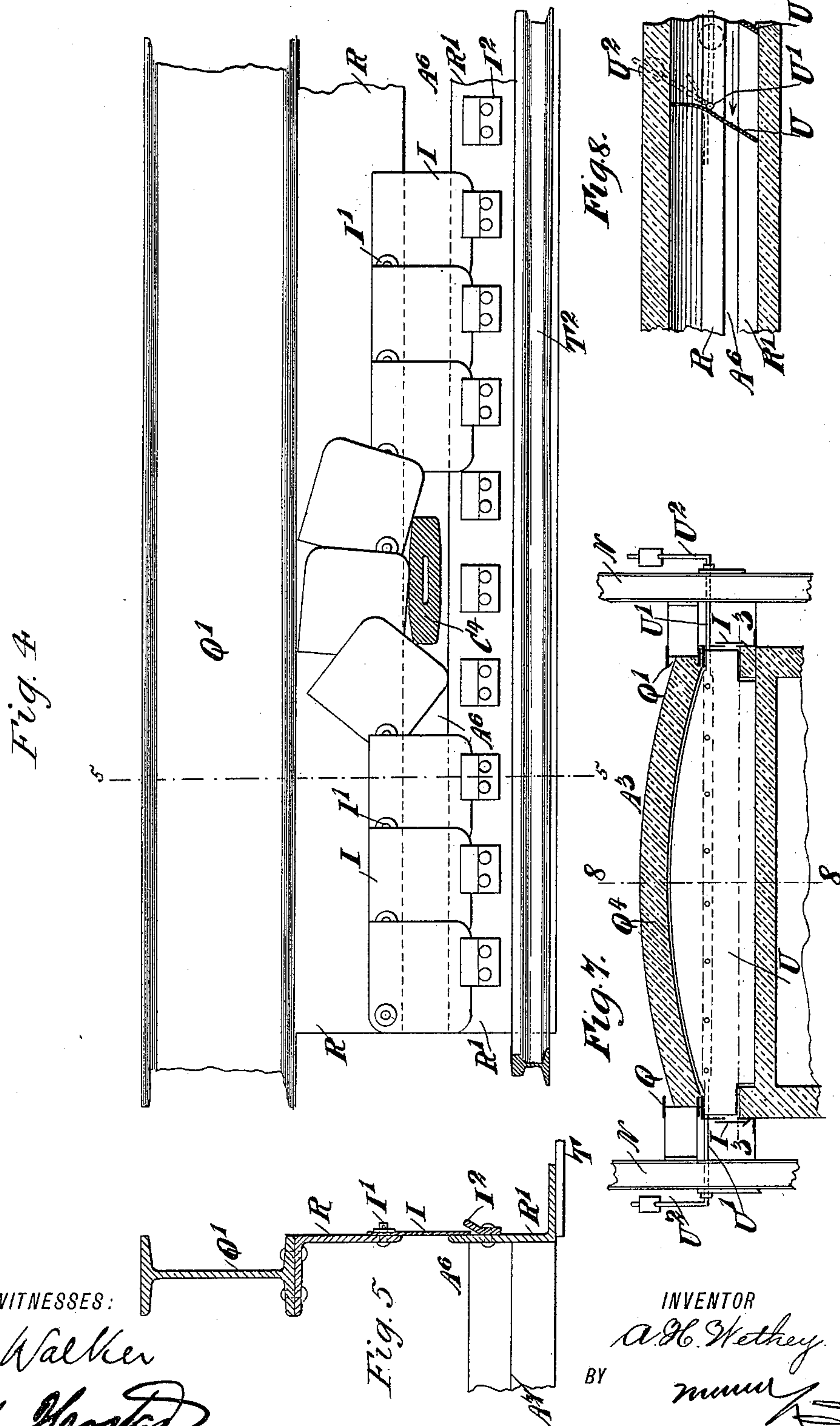
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(No Model.)

4 Sheets—Sheet 4.



WITNESSES:

J. B. Walker
Rev. G. Hooker,

INVENTOR

A. H. Wethey

BY

manu
ATTORNEYS

ATTORNEYS.

UNITED STATES PATENT OFFICE.

ARTHUR HARVEY WETHEY, OF BUTTE, MONTANA.

CALCINING-FURNACE.

SPECIFICATION forming part of Letters Patent No. 640,058, dated December 26, 1899.

Application filed January 24, 1896. Serial No. 576,713. (No model.)

To all whom it may concern:

Be it known that I, ARTHUR HARVEY WETHEY, of Butte, in the county of Silver Bow and State of Montana, have invented a new and Improved Calcining-Furnace, of which the following is a full, clear, and exact description.

The object of the invention is to provide a new and improved single calcining and desulfurizing furnace designed for rapidly and thoroughly desulfurizing ores and other material in a ground, pulverized, crushed, or concentrated state and without loss or waste of material, said furnace being arranged in such manner that the plows, stirrers, and like devices for agitating and moving the material in the hearths are actuated and carried forward by machinery located on the outer sides of the hearths.

This furnace is an improvement upon double-hearth furnaces such as shown in my Patents No. 559,647, dated May 5, 1896, and No. 565,313, dated August 4, 1896, in which superposed hearths are arranged in pairs or opposite each other in the same horizontal plane, a traveling rake being adapted to work on each such pair of hearths and supported by and traveling on rails arranged in the central space between the hearths. My present invention comprises a series of superposed single hearths supported by two opposite rows of vertical posts, between which and the longitudinal sides of the hearths are arranged on suitable supports connected with the said posts the rails whereon the rake-wheels travel. The brickwork of the hearths and arches is carried by longitudinal I-beams extending along both sides of each hearth and supported by devices connected with the vertical posts. This construction and arrangement of parts have been found to possess important advantages in various particulars.

Reference is to be had to the accompanying drawings, forming a part of this specification, in which similar characters of reference indicate corresponding parts in all the figures.

Figure 1 is a side elevation of the improvement. Fig. 2 is an enlarged cross-section of the same on the line 2 2 of Fig. 1. Fig. 3 is an enlarged sectional plan view of the same on the lines 3 3 of Figs. 1 and 7. Fig. 4 is an enlarged side elevation of the tripping-door

arrangement. Fig. 5 is a cross-section of the same on the line 5 5 of Fig. 4. Fig. 6 is an enlarged sectional side elevation of part of the improvement on the line 6 6 of Fig. 2. Fig. 7 is a cross-section of the improvement, showing the end door; and Fig. 8 is a sectional side elevation of the same on the line 8 8 of Fig. 7.

The improved furnace is provided with a number of hearths $A A' A^2 A^3$, located one above the other and connected with each other by openings A^4 , (see Fig. 3,) so that a continuous chamber is formed for the ore or other material to pass through and also for the combustion-gases to travel with the ore from one hearth to another, so as to successively pass through all the hearths, as hereinafter more fully set forth. The upper hearth A^3 is provided on one end and preferably in the top with an ore-supply hopper B (see Fig. 1) for feeding ore and like material into this end of the hearth A^3 , the ore then being moved forward in the direction of the arrow a' along the bottom or floor of the hearth by stirring and moving devices C until the ore reaches the opening A^4 , through which it drops into the right end of the next lower hearth A^2 . The ore is now moved to the left—that is, in the inverse direction of the arrow a' —by the stirring devices C on their return movement until the ore reaches and drops through an opening similar to the opening A^4 and located in the bottom of the hearth A^2 near the left end thereof. The ore now passes into the third hearth A' and is moved along the same in the direction of the arrow a' by another set of stirring devices C' until it reaches and drops through an opening similar to the opening A^4 in the right end of the lower hearth A , in which the ore is moved along to the left by the returning stirring devices C' to finally pass into hoppers A^5 , from which the ore can be discharged into a wagon or cart D , arranged below said hoppers, as indicated in Fig. 1. (See also Fig. 2.) It will be seen that the ore passes successively from one hearth to another, finally reaching the lowermost hearth A . The heating gases or products of combustion follow the same path as the ore, passing from one hearth to the next one below through the openings, such as A^4 , whereby one hearth communicates with the adjoining one. To se-

cure this result, I provide the following arrangement:

On each side of the furnace is located a fire-box E, of any approved construction, receiving its fuel-supply from a delivery-chute F, as indicated in Fig. 1. The products of combustion pass from the fire-box through a channel E' into the hearth A³ at the top thereof and next to the ore-supply, so that said products of combustion travel forward in the hearth A³ with the ore to pass into the next hearth A² and along the same to the left, then down through the hearth A² and forwardly therein a suitable distance, and thus down to the lower hearths A' and A in the same manner as has been described above with reference to the ore. Between the hearths A² and A' and communicating with the latter is arranged an outlet-channel G'. The products of combustion from the fire-box E after passing through the hearths A³, A², and A' and the products of combustion from the ore still burning in the hearth A pass through the opening or channel G' to the upper ends of stacks G, arranged on the sides of the furnace. By this arrangement the fumes and heat of the two upper hearths A³ A² travel downward to reach the stacks G, while the fumes and heat in the two lower hearths A' and A travel upward to reach said stacks. The lower ends G² of the stacks G discharge into a longitudinally-extending flue H, arranged under the lowermost hearth A to carry the waste gases to a chimney connected with said flue.

It will be observed that in the construction above described the gases from the fire-box E travel only through the hearths A³, A², and A', while in the lowermost hearth A the ore is heated only by its own products of combustion.

The superposed hearths are separated vertically by spaces which form longitudinal slots A⁶ at the sides, and such slots are normally closed by suitable trip-doors I. (See Figs. 4 and 5.) Stirrers C C', &c., are adapted to operate on the several hearths, which consist, primarily, of transverse shafts having radial flanges or shovels for stirring the ore and coal. The ends of such shafts are supported by carriages J J', &c., that run on rails J², supported in the space between the sides of the hearths and the posts N, whereby the said carriages are adapted to travel longitudinally on the outer sides of the furnace and shielded from the heat in the hearth by the doors I, above mentioned, said carriages being propelled forwardly in the direction of the arrow a' on the outer sides of the hearths A³ and A' and returned in the opposite direction on the outer sides of the hearths A² and A by suitable propelling mechanisms, preferably in the form of endless chains or cables K K', respectively, passing over driven pulleys L L', respectively, on the front end of the furnace and over idle pulleys L² L³, respectively, arranged on the opposite or rear end of the furnace. (See Figs. 1 and 3.)

In order to render the above-described arrangement practical, I construct the furnace in detail as follows:

Two parallel rows of posts N N' are erected on suitable foundations, and the posts are placed suitable distances apart, with the posts in the rows arranged directly opposite each other, as indicated in Fig. 3. Each post N or N' is formed of two vertically-disposed beams connected with each other by castings or brackets O, supporting transverse beams P, connecting two opposite posts with each other, and from such beams depend U-shaped bolts or stirrups Q², attached to the longitudinal I-beams Q and Q', upon which the arch rests. Metal castings Q³ are bolted to and connect these beams and the posts N N', and thus serve as lateral braces for the arch and also as brackets affording vertical support for the arch, whereby they supplement one of the functions of the aforesaid transverse beams and the U-bolts above referred to against lateral thrust of the arch, as well as assist in carrying or vertically supporting the weight of the arch and hearth with their side walls. To the under side of the longitudinal beams Q Q' are securely bolted auxiliary beams or angle-irons R, opposite to which are arranged like angle-irons R', forming with the said angle-irons R the slots A⁶ for the passage of the ends of the stirring devices traveling through the hearth.

Resting on the transverse beams P are longitudinally-extending I-beams S, carrying sheets or plates S', on which rest the floors S² of the hearths, made of brick or like material, it being understood that each set of transverse beams is for supporting the floors for the hearths A', A², and A³, the floor for the lowermost hearth being directly built up from the ground by suitable brickwork.

The angle-irons R', previously referred to, form braces for the lower sides A⁷ of the hearth, the sides extending a short distance above the floors S² to prevent the ore or like material under treatment from passing into and through the slots A⁶ to the outside. The angle-irons R' are securely bolted to castings or brackets T, attached to the vertical beams of the posts N N', the inner ends of said brackets being preferably walled in in the sides A⁷, as indicated in Fig. 2. The brackets T also support longitudinally-extending rails J², on which travel the wheels of the carriages J J', it being understood that said rails and carriages are a suitable distance from the sides of the hearth, so that the heat from within the hearth does not injure said carriages and the propelling mechanism for the same. Thus sufficient room is left between the sides of the hearth and the posts N N' for the carriages and working machinery used for propelling the stirring devices.

Each arch Q⁴ supports a transversely-extending brick wall Q⁵ on each side of a transverse beam P, so that the latter is protected from the heat, as there is an air-space around

the beam from outside to outside of the furnace. The brick walls Q^5 connect with the floor above the arch, thereby forming dead-air spaces for preventing loss of heat by radiation and insuring a light but strong construction of the furnace.

Each of the stirring devices $C C'$ is provided with shovels or stirrers C^2 , secured angularly on a hollow tube or shaft C^3 , connected at its outer ends by a threaded sleeve C^4 to a metallic cable K , attached to a plate J^3 , forming the frame for the carriage J or J' , said plate supporting the carriage-wheels J^4 , which travel on the track-rails J^2 inside of the posts $N N'$. The driving-pulleys $L L'$ are driven by suitable belts or cables from an overhead pulley L^4 , and the idle pulleys L^2 and L^3 are preferably mounted in journal-boxes L^5 , fitted to slide longitudinally in suitable guideways and engaged by weights L^6 for holding said journal-boxes and idle pulleys in an innermost position to hold the chains or cables $K K'$ in a comparatively taut condition.

Each outer end of a hearth is closed by suitable doors U , (see Figs. 1, 7, and 8,) preferably two in number, and mounted to swing and each carrying on its pintle U' a counterbalancing-weight U^2 to permit the door to open for the entrance or exit of the stirring devices, said door then automatically closing as soon as the stirring devices have passed. The two doors U at each end are placed far enough apart so that one is closed while the other is opened by the stirring device to prevent any escape of the heat within the hearth. The doors I for the slots A^6 and shown in detail in Figs. 4 and 5 are preferably pivoted at I' at one upper corner to the angle-iron R , while the lower edge is adapted to rest on a suitable lug I^2 , secured to the outside of the lower angle-iron R' . Now it will be seen that when the sleeve C^4 of a stirring device strikes the edge of the door I then the latter is swung upward into the position shown in Fig. 4 to permit the passage of the sleeve, and when the latter has passed a door then the door swings back by its own gravity to its normal position, resting with its lower edge on the lug I^2 , as will be understood by reference to said Figs. 4 and 5. The fire-boxes E are supported from some of the posts $N N'$, and in addition columns E^2 are employed, as will be readily understood by reference to Fig. 2.

It is understood that by the arrangement described a furnace of any desired length can be built or an existing furnace lengthened, if desired. It will further be understood that I do not limit myself to the connection of the fire-boxes E with the upper hearth A^3 at the point indicated, as the fire-boxes can be connected with any of the hearths at any desired point. For instance, another fire-box may be connected with the second hearth A^2 , as indicated at E^2 in Fig. 1, or a fire-box may be con-

nected directly with the lowermost hearth A , as indicated at E^3 in the same figure.

Having thus fully described my invention, I claim as new and desire to secure by Letters Patent—

1. A furnace structure comprising a series of superposed horizontal hearths and roof-arches therefor, the same being separated by slots at the sides, two opposite rows of vertical posts arranged along the side walls of the hearths, longitudinal beams upon which the arches rest at the sides, means connecting the said beams with the posts and supporting them upon and spacing them from the latter, rakes arranged on the hearths, and projecting through the side slots, carriages for carrying the ends of the rakes, rails for said carriages, and supports for the rails upon which the latter are held in the lateral spaces intermediate the posts and sides of the hearths, substantially as described.

2. A furnace having two or more superposed ovens with the roof of one oven and the floor of the one next above connected together, and provided along their sides with horizontal longitudinally - arranged metal beams, the said ovens having open slots at the sides, a series of vertical posts offset from the horizontal longitudinal beams, means for sustaining the said roofs and floors, said means being arranged between said connected roofs and floors on one hand and the vertical posts on the other, and connected and supported upon the vertical posts, a rake extending through the oven, and having upon its ends truck-wheels arranged between the longitudinal horizontal beams and posts, and rails or trackways exterior of the furnace-walls and upon which the above-named wheels run.

3. In a furnace, the combination with vertical side beams, or posts, of a series of vertically-superposed ovens having open side slots and arranged between the said posts with a space intervening the posts and ovens proper at each side, said ovens having the roof of one connected to the floor of the one next above, and said combined roof and floor being connected to and supported upon the vertical posts by supports extending across the side spaces between the posts and ovens.

4. In a furnace structure having heating-chambers provided with longitudinal openings through their side walls, the combination with horizontal longitudinally-disposed beams carrying the floors and roof-arches of the heating-chambers, of vertical supporting posts or columns ranged along the side walls of the heating-chambers adjacent to the longitudinal openings therein and spaced away from said side walls, brackets interposed between the vertical and horizontal beams and secured to each, transverse beams and stirrups connecting said posts and horizontal beams, rails and attachments supported upon the vertical posts and interposed between the latter and side walls of

the heating-chambers, for supporting said rails, substantially as and for the purpose set forth.

5. In a furnace structure, having heating-chambers with longitudinal openings through their side walls, the combination with horizontal longitudinally-disposed beams, carrying the floors and roof-arches of such heating-chambers, of vertical posts ranged along the side walls of the heating-chamber adjacent to the longitudinal openings therein, and spaced away from said side walls, devices connected with the vertical posts and constituting a partial means of support for the horizontal beams, the same being interposed between said vertical posts and the side walls of the heating-chambers, transverse beams and stirrups connecting said posts and horizontal beams, and a track supported between the side walls and posts, as described.

6. A calcining-furnace comprising a horizontal hearth and roof separated by longitudinal side slots, a series of vertical posts arranged along the sides thereof, and spaced away therefrom, partial means of support for said hearth which extend between it and the posts and connect it with the latter, a rake that runs over the hearth, wheels for said rake, means for moving the rake, and rails arranged with said wheels in the spaces intervening the hearth and posts, and means for supporting said rails, substantially as shown and described.

7. A calcining-furnace comprising a series of horizontal hearths and roofs arranged one above another, but separated by horizontal spaces and having longitudinal side beams, vertical posts arranged on both sides of the hearths, and spaced away therefrom, means for connecting the side beams with and supporting them upon said posts, rails arranged between the posts and sides of the hearths, means for supporting said rails, rakes working longitudinally of the hearths, and carriages for the rakes which run on said rails.

8. A calcining-furnace, comprising a series of horizontal hearths and roofs for the same, longitudinal beams upon which the hearths rest at the sides, vertical posts arranged alongside the body of the furnace and spaced away therefrom, supports for the said beams which are connected with the said posts, rails supported intermediately of the posts and hearths, horizontal spaces or slots that intervene the hearths and their roofs and extend through the sides and ends of the furnace, stirring devices adapted to pass over the hearths and travel on the aforesaid rails, and tripping-doors adapted to normally close the side slots and allow passage of the tripping devices, substantially as shown and described.

9. A calcining-furnace comprising a series of superposed hearths and roofs, vertical posts arranged alongside the same, and spaced away therefrom, hearth-floor supports connected with the posts and extending inwardly therefrom, a space or slot that intervenes

each hearth and its roof and extends through the sides and ends of the furnace-body, stirring devices adapted to travel through such side slots or spaces, tripping-doors for normally closing the slots, rails supported away from the sides of the hearths and between the latter and the posts, and carriages supporting the stirring devices, and adapted to travel on said rails, substantially as shown and described.

10. A calcining-furnace comprising superposed hearth-floors and roof-arches separated by horizontal spaces which open at the sides and ends as continuous slots, vertical posts alongside the hearths and spaced away therefrom, supports extending inwardly from the posts and connected with the hearth floors and arches, rails supported in the space between the posts and hearths, and a stirring device which extends through the side slots and passes bodily out through the end slots and around the end of the hearth-floor, as shown and described.

11. A calcining-furnace comprising a series of connected hearths one above the other and forming a continuous roasting-chamber through which is adapted to travel the ore or other material to be treated, fire-boxes discharging into one of said hearths and stacks leading from one of said hearths for carrying off all fumes, said stacks discharging at their lower ends into a longitudinal flue connected with a chimney, substantially as shown and described.

12. A calcining-furnace comprising rows of posts, transverse beams supported thereby, longitudinal I-beams carried by said transverse beams, and hearths or floors whose sides rest upon such beams, substantially as shown and described.

13. A calcining-furnace comprising rows of posts, transverse beams connecting opposite posts with each other, longitudinal I-beams carried by said transverse beams, floors supported by said I-beams, a second set of longitudinal I-beams suspended from said transverse beams, and roof-arches carried by the last-mentioned I-beams, substantially as shown and described.

14. A calcining-furnace comprising rows of posts, transverse beams connecting opposite posts with each other, longitudinal I-beams carried by said transverse beams, floors supported by said I-beams, a second set of longitudinal I-beams suspended from said transverse beams, roof-arches carried by the last-mentioned I-beams, brackets attached to said posts, and rails carried by said brackets, substantially as shown and described.

15. A calcining-furnace comprising rows of posts, transverse beams connecting opposite posts with each other, longitudinal I-beams carried by said transverse beams, floors supported by said I-beams, a second set of longitudinal I-beams suspended from said transverse beams, roof-arches carried by the last-mentioned I-beams, brackets attached to said

posts, rails carried by said brackets, angle-irons secured to the suspended I-beams and said brackets, and the longitudinal slots in the sides of the hearths, substantially as shown and described.

16. A calcining-furnace comprising rows of vertical posts, transverse beams connecting opposite posts with each other, longitudinal I-beams carried by said transverse beams, floors supported by said I-beams, a second set of longitudinal I-beams suspended from said transverse beams, brackets attached to the vertical posts and partially supporting said second set of longitudinal I-beams, roof-arches carried by the second set of longitudinal I-beams and separated from the floors by side spaces or slots, brackets attached to said posts, rails carried by said brackets, exterior of the furnace-walls, and carriages arranged to travel on said rails and carrying rake-bearing devices, substantially as shown and described.

17. A calcining-furnace comprising rows of vertical posts arranged in pairs, brackets connecting the posts of each pair, transverse beams resting on said brackets between the posts, longitudinal beams supported by the transverse beams, and a hearth carried by the longitudinal beams, substantially as described.

18. A calcining-furnace comprising two opposite rows of vertical posts spaced away from its side walls, hearth and rail supports extending inwardly from the posts, rails arranged between the said walls and posts, a plurality of superposed hearths or floors and roof-arches located in different horizontal planes and having side and end walls provided with spaces

which separate the hearths vertically from their arches, said walls having continuous open slots transverse beams and stirrups partially supporting the arches and connecting the hearths with the posts, chains extending parallel to the side slots, and exterior of the furnace-walls, pulleys on which said chains run, and stirring devices secured to said chains and having their ends extended transversely through the said side slots, whereby the stirring devices may traverse and be carried from one hearth-floor around its end to another substantially as shown and described.

19. In a furnace structure, the combination with superposed hearths or ovens and their roof-arches, said ovens having walls provided with open slots, of vertical parallel posts spaced away from said side walls, transverse beams carried by said posts, longitudinal beams upon which the sides of the arches rest, stirrups which connect the two sets of beams, and brackets which are interposed between the beams and posts, substantially as shown and described.

20. A calcining-furnace provided with a hearth having a continuous longitudinal slot in each side, tripping-doors for closing such slots, said doors overlapping one another, and each door being pivoted at one upper corner and supports arranged to engage the doors at their lower edges, substantially as shown and described.

ARTHUR HARVEY WETHEY.

Witnesses:

THEO. G. HOSTER,
A. A. HOPKINS.