(No Model.)

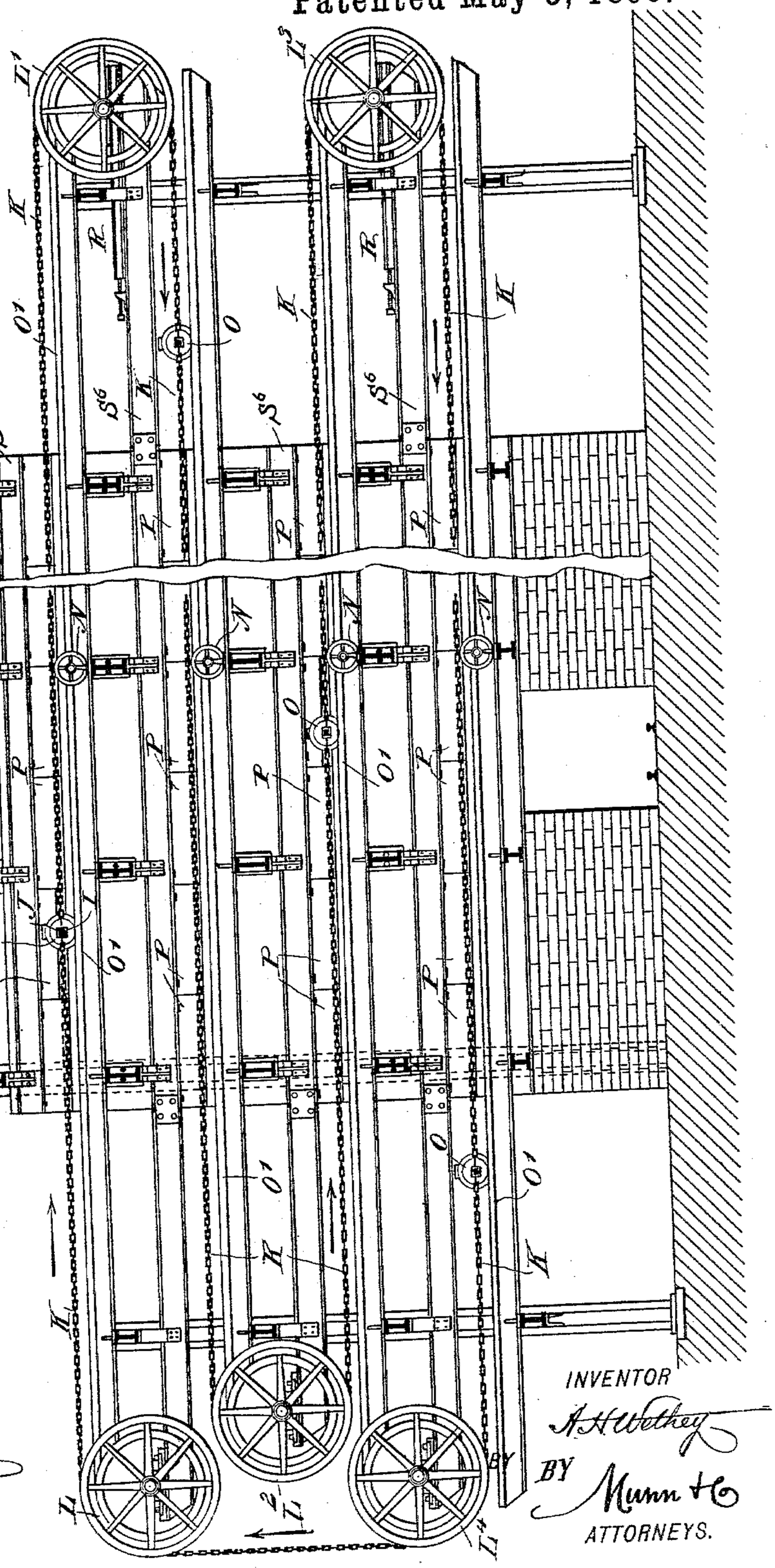
3 Sheets—Sheet 1.

# A. H. WETHEY.

## CALCINING FURNACE.

No. 559,647.

Patented May 5, 1896.



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C. Sedgwick

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(No Model.)

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## CALCINING FURNACE.

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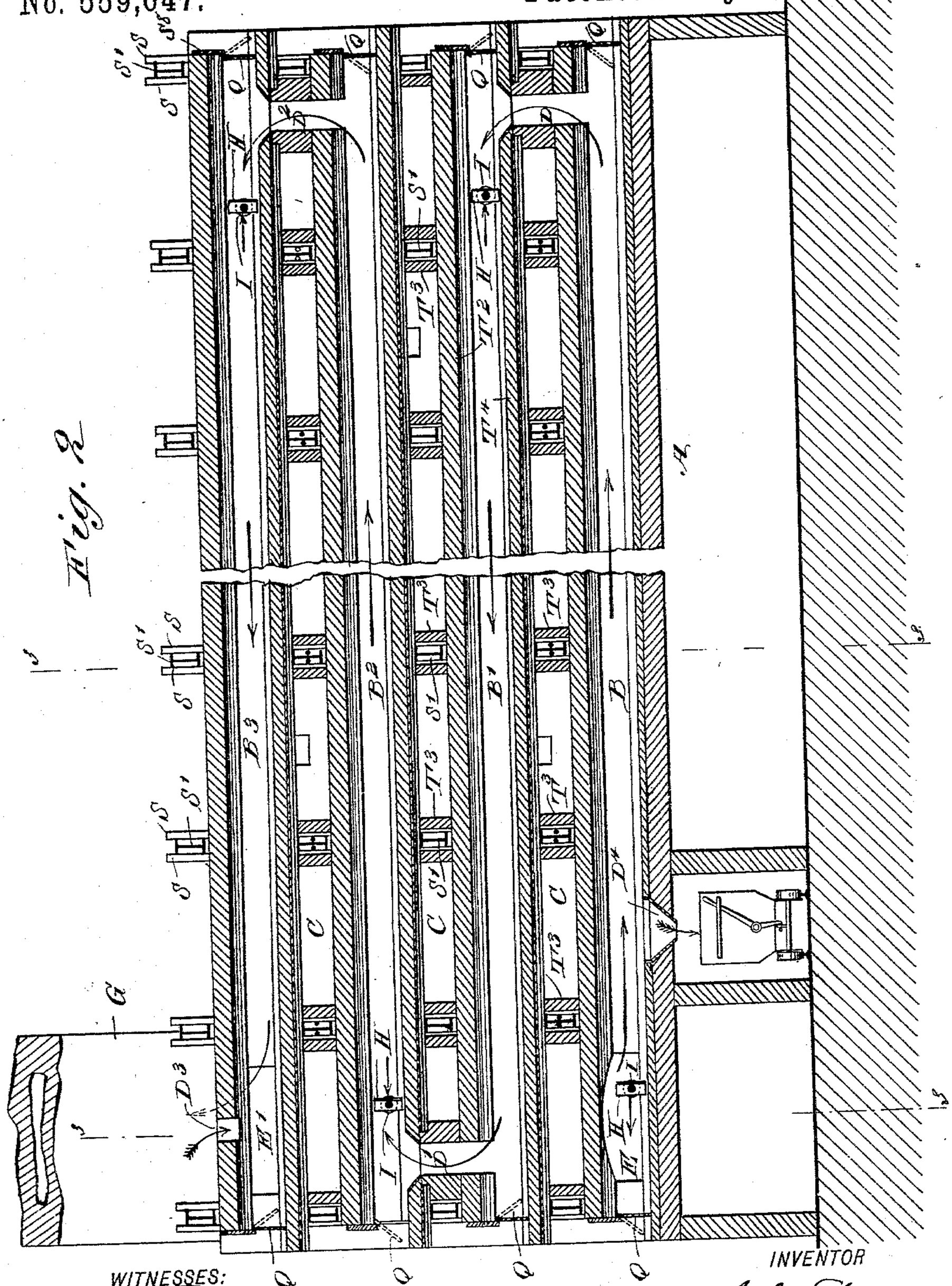
Fig. 2.

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3 Sheets—Sheet 3.

# A. H. WETHEY.

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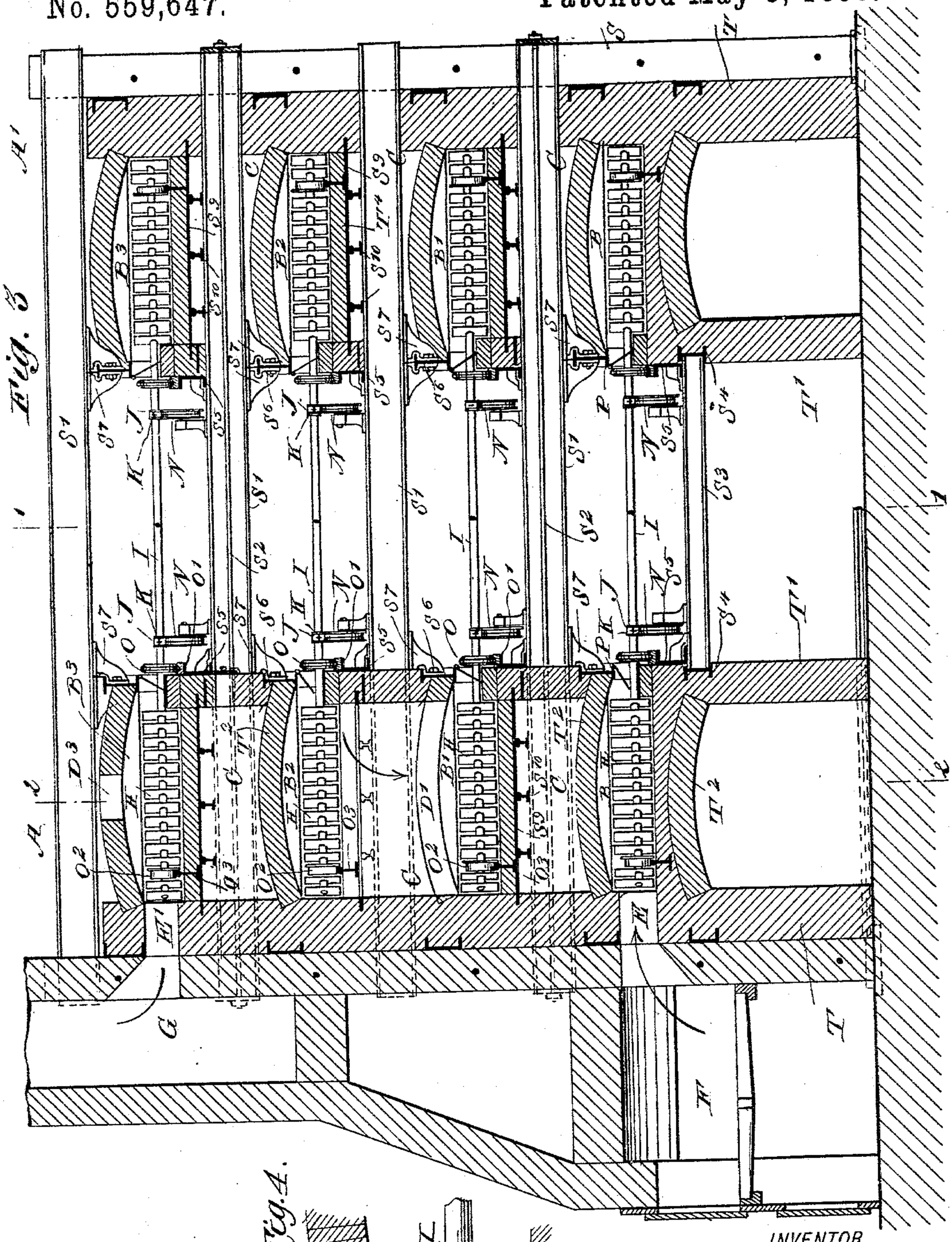

Fig. 5.

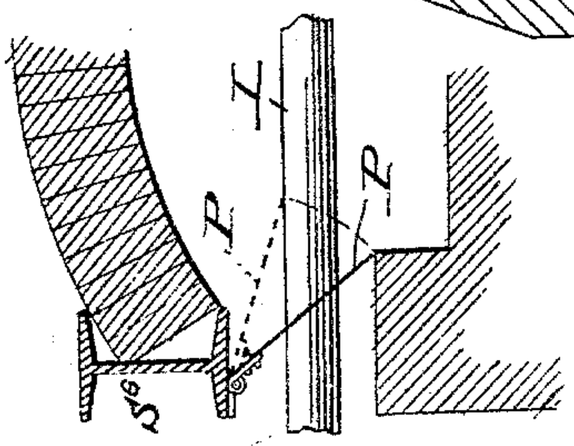

Fig. 4.

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# UNITED STATES PATENT OFFICE.

ARTHUR HARVEY WETHEY, OF BUTTE, MONTANA.

## CALCINING-FURNACE.

SPECIFICATION forming part of Letters Patent No. 559,647, dated May 5, 1896.

Application filed February 2, 1894. Serial No. 498,921. (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 calcining or desulfurizing furnace designed for rapidly and thoroughly desulfurizing ores and other material in a ground, crushed, pulverized, or concentrated state, and without loss or waste of material.

The invention consists principally of roasting-compartments located one above the other and connected in such a manner as to form a continuous chamber for the passage of the ore and the heat, the latter traveling in an opposite direction to the movement of the ore, and a stirring device comprising an endless traveling chain having its several runs passing longitudinally alongside the said compartments, and plows or stirrers carried by the said chain and adapted to travel through the several compartments, to stir up the material under treatment, and to move the same forward to permit it to finally drop from an upper compartment into the next lower one at or near the ends thereof.

The invention also consists of certain parts and details and combinations of the same, as will be hereinafter described and then pointed out in the claims.

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

Figure 1 is a longitudinal section of the improvement on the line 1 1 of Fig. 3. Fig. 2 is a longitudinal section of the same on the line 2 2 of Fig. 3. Fig. 3 is an enlarged cross-section of the same on the line 3 3 of Fig. 2. Fig. 4 is a detail view showing how doors P operate.

The drawings illustrate a double or pair furnace—that is, one having both sides alike; but it is evident that a desired number of furnaces can be constructed on the same plan without deviating from the invention.

As the two furnaces A A′ shown in the drawings are alike in construction, it suffices to describe but one in detail. Each furnace A A′ is provided with a series of longitudinally-extending compartments B B′ $B^2$ $B^3$, located one above the other, as plainly shown in Fig. 2, and separated from each other by dead-air spaces C. The lowermost compartment B is connected at its right-hand end by a vertical channel D with the corresponding end of the next compartment B′, and the latter is connected at its left-hand end by a corresponding vertical channel D′ with the corresponding end of the third compartment $B^2$, and the latter is connected at its right-hand end by a channel $D^2$ with the corresponding end of the uppermost compartment $B^3$. The latter is provided in its roof or top wall and at the left-hand end with a charging-opening $D^3$, through which the material to be treated is introduced into the corresponding furnace A or A′. In the bottom of the lowermost compartment B, and near the left-hand end thereof, is arranged an outlet $D^4$, through which the roasted or desulfurized material is finally discharged from the furnace in the manner hereinafter more fully described, the material dropping into a car or other suitable vessel located below the said outlet-opening $D^4$. (See Fig. 2.)

In the lowermost compartment B and at the left of the outlet-opening $D^4$ is arranged a heat-inlet opening E, connected with a fire-box F of any approved construction, (see Fig. 3,) so that fuel burning in the said fire-box discharges its heat through the opening E into the lowermost compartment B, along which the heat passes, to finally pass by the channel D into the next compartment B′, located above it, to pass along the same, and to then pass, through the channel D′, into the third compartment $B^2$, along the same, and through the channel $D^2$ into the uppermost compartment $B^3$, from which it finally passes through an opening E′ into the chimney G. (See Figs. 2 and 3.)

The material under treatment passed into the uppermost compartment $B^3$ through the opening $D^3$ travels in an opposite direction to the movement of the gas and heat above described—that is, it passes first along the compartment $B^3$, drops through the channel $D^2$ into the compartment $B^2$, is then moved along the same to drop through the channel D′ into the compartment B′, to be moved along

the latter to then drop through the channel D into the compartment B, to be moved along the latter to be finally discharged through the outlet $D^4$ into the car located below it. By this arrangement the material is first subjected to heat of comparatively low temperature and is gradually moved into a higher temperature, reaching its highest point previous to the material being discharged through the opening $D^4$, as above explained. Now in order to move the material through the several compartments in the manner described the following device is provided: Through each of the compartments are adapted to pass stirring devices, each having a number of shovels or plows H secured on a transversely-extending shaft I, reaching from one furnace to the other and extending into the corresponding compartments thereof, as will be readily understood by reference to Fig. 3. Each shaft I is engaged outside of the inner walls of the furnace A and A′ by cross-heads J, secured on endless traveling chains K, each passing over the pulleys L, L′, $L^2$, $L^3$, and $L^4$, of which the pulleys L, $L^2$, and $L^4$ are arranged a suitable distance from one end of the furnace, while the other pulleys L′ and $L^3$ are similarly arranged a suitable distance from the other end of the furnace, as will be plainly seen by reference to Fig. 1. It will further be seen that the several pulleys are located one above the other in such a manner that the several runs of the endless chain K pass in alinement with the respective compartments B B′ $B^2$ $B^3$, so that a single shaft I is carried successively from one compartment to the next one and in an opposite direction to its former movement.

In order to support the runs of the chain K between the corresponding oppositely-arranged sets of pulleys, I provide carrier-pulleys N, journaled in suitable bearings supported on a skeleton frame of the furnace between the inner walls thereof. In order to support the shafts I in the proper position during their passage through the several compartments, I provide each shaft with an exterior wheel O, traveling in a correspondingly-shaped rail O′, secured to the outer face of the inner wall of the corresponding furnace A or A′. In order to sustain the inner ends of the shafts I, I provide the same with similar wheels $O^2$, traveling on rails $O^3$, extending within the respective compartments B, B′, $B^2$, and $B^3$. Now it will be seen that when the chain K receives a traveling motion by rotating any one of the pulleys L, L′, $L^2$, $L^3$, or $L^4$ then a traveling motion is given to the several shafts I, so that the latter pass successively through the several compartments B B′ $B^2$ $B^3$ to move the material by their shovels H in the direction above described, it being understood that the material is first moved in the uppermost compartment $B^3$ from the inlet-opening $D^3$ to the channel $D^2$, through which the material drops into the next following compartment $B^2$ to be moved along the same to be finally permitted to drop through the channel D′ into the compartment B′, and so on, as above described.

In order to prevent air from passing into the compartments at the ends and the inner walls, I provide the inner walls with self-closing doors P, which are opened by the moving shafts I, and the ends of the said compartments are provided with similar doors Q, adapted to be opened by the shovels H and adapted to close as soon as the shovels or plows have passed into or from the respective end. The doors P are pivoted at their upper edges to the I-beams $S^6$, with their lower free edges resting on the brickwork at the side of the hearth, as clearly shown in Fig. 4. When the rear ends of the doors are engaged by the shafts I, the doors will swing inwardly and upwardly till said shafts pass and then drop again into their closed positions.

It will be seen that the shovels or plows in their movement through the several compartments stir up and agitate the material contained therein, at the same time moving it gradually forward to permit it to drop to the next following compartment, as above described, so that the material is thoroughly subjected to the action of the heat passing through the compartments in an opposite direction to the movement of the material. In order to hold the endless traveling chain K sufficiently tight, I mount the pulleys L′ and $L^3$ on longitudinally-adjustable bearings R of any approved construction and arranged to take up any slack occurring in the chain.

The furnaces A and A′ are preferably constructed, as shown, and are provided with a metallic skeleton frame and a brickwork composed principally of the outer walls T, the inner walls T′, and the arches $T^2$, as plainly illustrated in Fig. 3.

The metallic skeleton frame is provided with sets of channel-beams placed suitable distances apart on each outer face of the outer walls T, each set of channel-beams being composed of two channel-beams S tied together, each two oppositely-arranged sets of beams forming a support for a transversely-extending main I-beam S′, which acts as a binder or backstay for both furnaces A A′. The beams S S′ of a set are tied together by rods $S^2$, one on each side of the main beam S′, as plainly shown in the drawings. Short beams $S^3$ are employed to connect the inside walls T′ of the two furnaces with each other, and these beams $S^3$ rest on longitudinal beams $S^4$, set or built in the inner walls T′. The I-beams S′ and $S^3$ support channel-beams $S^5$, which in turn support the track-rails O′, on which the wheels O travel, as previously described.

From the main I-beams S are suspended secondary I-beams $S^6$. By means of special castings $S^7$ these beams $S^6$ support one side of the arches $T^2$ above the hearth of each compartment B, B′, $B^2$, and $B^3$. (See Fig. 3.) The castings $S^7$ are securely bolted to the main I-beams S′ and are bolted together through the secondary I-beams $S^6$, which have

elongated holes, so that the beams can expand or contract freely.

From the I-beams $S^6$ the arches or roofs $T^2$ are swung over to the main outside walls T of the furnaces A and A', and the said beams also support short walls $T^3$, extending transversely and reaching to the floor of the next compartment above, so as to form the dead-air spaces C, previously described. The air-spaces C are preferably provided with ventilating-doors. On the ends of the arches $T^2$ are secured transversely-extending plates $S^8$, on which the end doors Q are hung, it being understood that the door at one end of a compartment swings inward, while the door at the other end swings outward. (See Fig. 2, full and dotted lines.)

The hearth $T^4$ of each compartment B, B', $B^2$, or $B^3$ is made of a fireproof material and set on a metallic plate $S^9$, supported on longitudinally-extending T-rails $S^{10}$, resting on the main beams S', as will be readily understood by reference to Fig. 3. The plates $S^9$ are made in sections of sheet iron or steel and placed suitable distances apart to allow for expansion.

It will be seen that by a furnace constructed in the manner described the material is readily calcined or desulfurized, and all the working parts of the furnaces can be readily reached, so that repairs of all kinds can be quickly effected at any time. The furnaces are so constructed that they can be enlarged at will, either by increasing the height by the addition of more compartments or by increasing the length of the compartments already built and increasing the number of the fire-boxes F and chimneys G, as the latter must be sufficient to remove all fumes and gases and allow sufficient draft for the processes of calcining to proceed in a proper manner. It will also be seen that the arrangement of the main beams permits a free expansion and contraction without causing any damage to the furnace, and also permits of increasing the size of the furnace at any time in the manner above described. The said beams also allow the free passage of the plows H into and out of the compartments at the ends thereof, thus permitting the plows to cool after they have passed once through the hot ore in one compartment and before again entering the next following compartment. It will also be seen that the working parts of the furnace—such as tracks, chains, and so on—are principally located outside of the compartments, thus preventing wear and tear, which would be caused by heat if they were located inside of the compartments. It will further be seen that the secondary beams $S^6$ are freely suspended and are thus free to expand and contract without injury to the arches supported by the same. It will also be seen that the falling of the ore or material from one compartment to another is to a considerable distance, so that any lumps or balls contained in the material are broken up on striking the hearth of the next following lower compartment. The falling of the ore through the heat moving in an opposite direction increases the rapidity of the desulfurizing process.

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

1. A calcining-furnace, comprising a series of roasting-compartments located one above the other and connected in such a manner as to form a continuous chamber for the passage of the ore and the heat, the latter traveling in an opposite direction to the movement of the ore, and a stirring and conveying device comprising an endless traveling chain having its several runs passing longitudinally outside the said compartments, and plows or shovels carried by the said chain and adapted to travel through the several compartments to stir up the material under treatment, and to move the same forward to permit it to drop from a compartment into the next lower one at or near the ends thereof, substantially as shown and described.

2. A calcining-furnace, comprising a series of roasting-compartments located one above the other, vertically-disposed channels connecting the compartments with each other at opposite ends so as to form a continuous chamber for the passage of the material to be treated, a fire-box discharging into one end of the lowermost compartment, a chimney connected with the end of the uppermost compartment to circulate heat from the said fire-box through the several compartments, and a stirring and conveying device comprising an endless traveling chain having its several runs passing longitudinally outside the said compartments, shafts carried by the said chain, and stirrers or shovels secured on the said shafts and adapted to pass in and through the said compartments, substantially as shown and described.

3. A calcining-furnace, comprising a series of roasting-compartments located one above the other, vertically-disposed channels connecting the compartments with each other at opposite ends so as to form a continuous chamber for the passage of the material to be treated, a fire-box discharging into one end of the lowermost compartment, a chimney connected with the end of the uppermost compartment to circulate heat from the said fire-box through the several compartments, a stirring and conveying device comprising an endless traveling chain having its several runs passing longitudinally outside the said compartments, shafts carried by the said chain, and stirrers or shovels secured on the said shafts and adapted to pass in and through the said compartments, and doors on the ends and inside of the said compartments, substantially as shown and described.

4. A calcining-furnace, comprising a series of roasting-compartments located one above the other, vertically-disposed channels connecting the compartments with each other at

opposite ends so as to form a continuous chamber for the passage of the material to be treated, a fire-box discharging into one end of the lowermost compartment, a chimney connected with the end of the uppermost compartment to circulate heat from the said fire-box through the several compartments, a stirring and conveying device comprising an endless traveling chain having its several runs passing longitudinally outside the said compartments, shafts carried by the said chain, and stirrers or shovels secured on the said shafts and adapted to pass in and through the said compartments, longitudinal rails, and wheels held on the said shafts and adapted to travel on the said rails to properly support the said shafts, substantially as shown and described.

5. A calcining-furnace, comprising an outer wall, an inner wall, arches between the inner and outer walls to form compartments located one above the other, sets of channel-beams arranged on the outer faces of the outer walls, transverse I-beams connecting corresponding sets of channel-beams with each other, secondary I-beams arranged longitudinally and suspended from the said transverse I-beams, the said secondary beams forming a support for one side of the said arches, longitudinally-extending rails supported on the said transverse I-beams, and sheet-metal plates supported on the said T-rails and adapted to carry the bricks forming the hearth of the compartment, substantially as shown and described.

ARTHUR HARVEY WETHEY.

Witnesses:
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ROBERT G. BROWN.