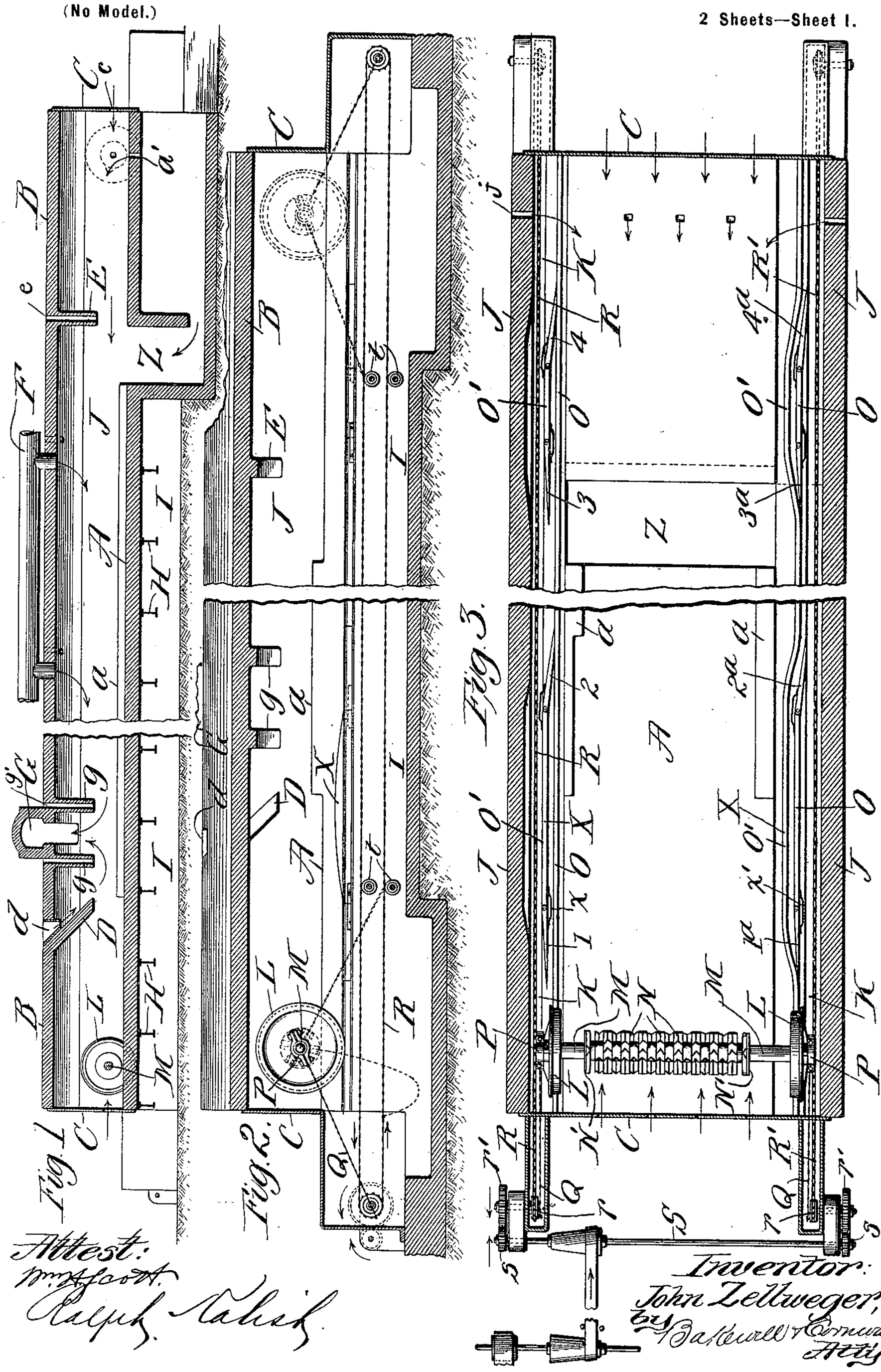
No. 627,609. Patented June 27, 1899.

J. ZELLWEGER.

ROASTING KILN.

(Application filed Feb. 28, 1898.)

(No Model.) 2 Sheets—Sheet 1.



THE NORRIS PETERS CO., PHOTO-LITHO., WASHINGTON, D. C.

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Fig. 4

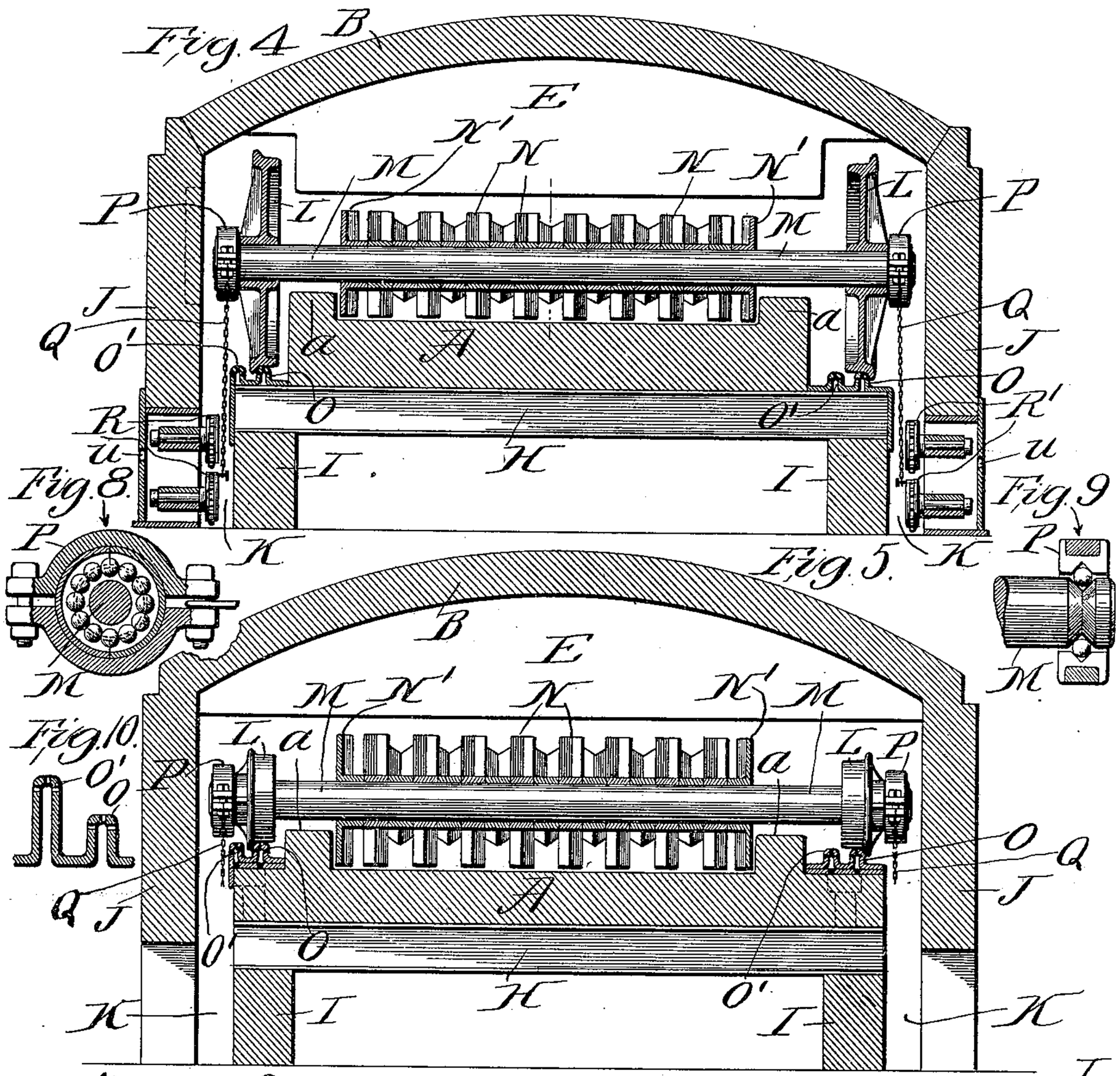


Fig. 8.

Fig. 5.

Fig. 9

Fig. 10.

Fig. 6.

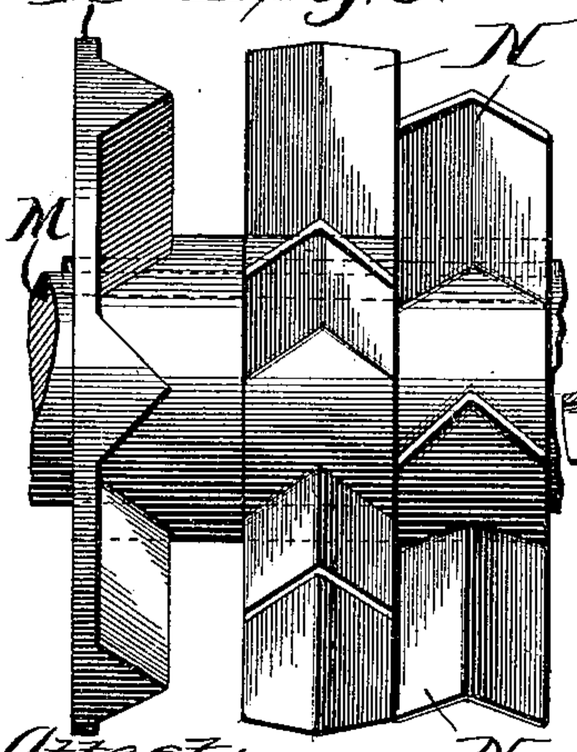


Fig. 7.

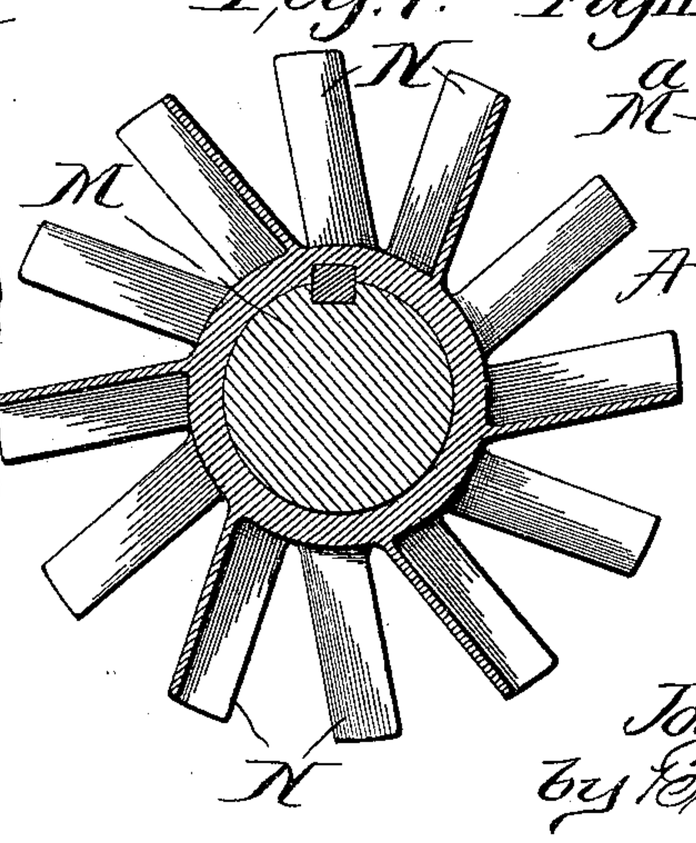
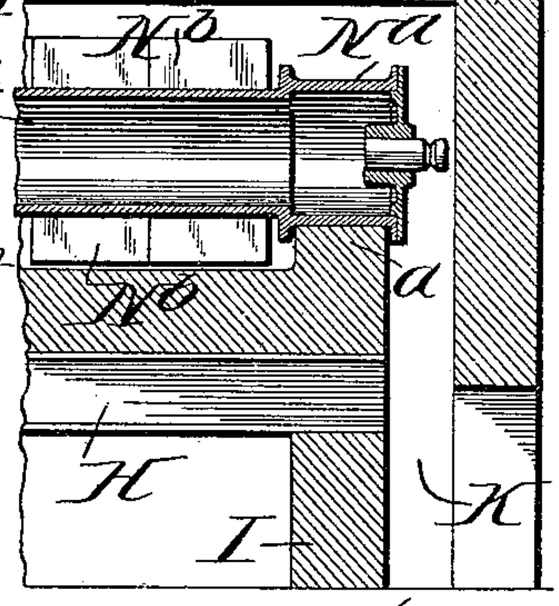


Fig 11



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UNITED STATES PATENT OFFICE.

JOHN ZELLWEGER, OF ST. LOUIS, MISSOURI.

ROASTING-KILN.

SPECIFICATION forming part of Letters Patent No. 627,609, dated June 27, 1899.

Application filed February 28, 1898. Serial No. 672,077. (No model.)

To all whom it may concern:

Be it known that I, JOHN ZELLWEGER, a citizen of the United States, residing in the city of St. Louis, State of Missouri, have invented a certain new and useful Improvement in Roasting-Kilns, of which the following is a full, clear, and exact description, such as will enable others skilled in the art to which it appertains to make and use the same, reference being had to the accompanying drawings.

This invention relates to that class of roasting-kilns in which a mechanical stirrer is employed for turning and mingling the charge, and is designed more particularly for use in connection with metal-bearing ores and analogous substances, although it is obvious that there may be other materials which may be roasted in my improved kiln.

In the drawings forming part of this specification, and in which like letters and numerals of reference refer to like parts, Figure 1 is a longitudinal sectional view through the kiln, taken approximately along its center line. Fig. 2 is a corresponding view, somewhat enlarged, taken through the near chain-pit. Fig. 3 is a horizontal sectional view taken above the hearth. Fig. 4 is an enlarged cross-sectional view through the kiln, the line of section including the stirrer, whose blades are here shown as being shorter than the radius of the supporting-wheels. Fig. 5 is a corresponding view in which the blades of the stirrer are shown longer than the radius of the supporting-wheels. Fig. 6 is a view in side elevation, illustrating the stirrer-blades in detail. Fig. 7 is a cross-sectional view through said stirrer-blades. Fig. 8 is a cross-sectional view through the roller-bearing on the ends of the stirrer-shaft. Fig. 9 is a detail view of one end of the stirrer-shaft in side elevation, showing the roller-bearing in position thereon. Fig. 10 is a detail cross-sectional view of the track-plate, and Fig. 11 is a modified form of stirrer in which the shaft is hollow and the blades disposed longitudinally thereof.

The effective roasting of material in kilns depends largely upon the frequent replacement of the roasted portion by other portions which are to be subjected to the roasting agency. Such replacement, which affects the capacity and efficiency of the kiln, may be effected either mechanically or manually with suitable stirrers, hoes, rakes, or plows. To be effectual, this stirring or agitation must act upon all the material to be roasted—that is, the material lying directly on the hearth should be carried to the surface, so as to be exposed to the proper heat, while the material previously on the surface and having been properly roasted can replace the raw material. This requirement can be met by manual manipulation of hoes, rakes, &c., but so far as I am aware has not been successfully accomplished up to the present time by mechanical devices which operate practically automatically.

In all continuous-working stirrers used heretofore with which I am familiar the stirrer blades or plows move in horizontal planes and do not positively heave the material—that is, turn the unroasted material up from the bottom, so that it can receive the proper heat and bury the roasted material—but, to the contrary, merely displace the unroasted and roasted material in the direction of least resistance. In my present invention I accomplish this upheaving of the unroasted material from the bottom and the burying of the roasted material by imparting to the stirrer-blades practically two motions with respect to their action on the material on the hearth—that is, a straight horizontal movement and a revolving motion around an axis arranged at right angles to the line of the first or longitudinal movement, said blades having, in this revolving motion, a speed at their point of action on the material either less or greater than the longitudinal movement to which I have referred. This difference in the speed of the two motions is essential for the working of the blades as lifting or heaving agents, because then their ends in rising from the lowest points move either slower or faster than the axis around which they revolve, and as a consequence drag or lift some of the material from the bottom toward the top. These two motions of the stirrer-blades are produced by arranging them on a shaft which extends across the hearth, which shaft is mounted upon wheels which roll over tracks located alongside the hearth and which wheels have a radius unequal to the reach of the blades or the

distance from the axis of rotation to the ends of the blades. For a wheel-radius larger than the reach of the blades, as illustrated in Fig. 4, the points of the blades describe a short cycloidal curve, and for a wheel-radius smaller than the reach of the blades, as illustrated in Fig. 5, the blades describe an extended or loop cycloidal curve. In the first instance the blades have a dragging action on the material, tending to push the material in the direction of the motion of the stirrer, and in the second instance they have a tendency to crowd or push the material in a direction opposite to the motion of the stirrer. In both cases the ends of the stirrer-blades pass through space at speeds unequal to that of their driving medium—to wit, their supporting-wheels—and as a consequence these blades near the lowest points of their cycloidal curves will so act upon the material that when they rise they will push the material forwardly and upwardly (in the instance of shorter blades) or backwardly and upwardly, (in the instance of the longer blades,) both actions being due to the inequality between the length of the supporting-wheel radii and of the reach or length of the blades. I prefer to fix the supporting-wheels on the ends of the shaft upon which the blades are mounted, which forms a rigid stirrer-frame, thereby enabling this frame to be moved over a track and hearth without the production of internal friction.

In the drawings, A indicates the hearth of the kiln, which is preferably provided along its sides where the material is operated upon with raised portions *a*.

B indicates the roof of the kiln.

C indicates the end plates for closing the ends of the kiln, which plates are preferably perforated, as at *c*, for the admission of air, as shown in Fig. 1.

D indicates a curtain-wall, preferably inclined, upon which the material to be roasted is admitted through an opening *d*. E indicates a curtain-wall located near the other end of the kiln, whose function, as well as that of the curtain D, is to prevent the escape of the hot air from the upper part of the kiln-chamber and to form cooling-chambers between said curtains and the end plates C, in which chambers the stirrers may cool.

F indicates a fuel-supply pipe admitting fuel, preferably in the form of gas, above the hearth, thus supplying the roasting agency, whose combustion is supported by the pure air entering the perforations in the roof of the kiln and in the end plates C and from the chain-pits on each side of the hearth, which will hereinafter be described.

G indicates a flue for carrying off the products of combustion, on each side of which are arranged curtains *g*, whose function is to cause the products of combustion before escaping through the flue to closely hug the hearth at this point.

The curtains *g* and E are preferably provided with openings *g'* and *e*, respectively, through which cool air is drawn by the chimney-draft to keep said curtains cool.

The hearth is suitably supported by transversely-disposed I-beams H, which are arranged upon suitable masonry I.

J indicates the side walls of the kiln, which are arranged outside the masonry I, so as to form spaces K, which I shall term the "chain-pits."

Z indicates the discharge-opening, into which the materials fall after being treated on the hearth A.

I will now describe the stirrer in detail and the manner in which the same is operated.

L indicates the supporting-wheels of my improved stirrer, which wheels are provided with guiding-flanges, as is usual, but I prefer to arrange these flanges on the outer sides of the treads.

M indicates the shaft on which the wheels L are mounted.

N indicates the stirrer-blades, which are arranged on shaft M. These stirrer-blades preferably extend from collar-sections, which are either feathered or otherwise fixed to the shaft, as shown in Figs. 6 and 7. The blades projecting from the different collar-sections are staggered with relation to each other; but the exact arrangement of the blades, as also their shape, is immaterial, I having illustrated a desirable form and arrangement. In cross-section the blades are preferably V-shaped, the convex side facing back or front, as suited to movement of the material being operated upon. The front face of a blade is that which pushes the material toward the discharge end. The shape best suited for a blade I have found to depend upon the way it revolves around the shaft in connection with the supporting-wheels, being of larger or smaller radius than its reach. For a wheel radius larger than the reach of the blade I prefer a concave front and a convex back. Where the wheel radius is smaller than the reach of the blades, I prefer a paddle-shaped blade. I also wish to remark that the blades may extend radially, or, as shown in Fig. 7, said blades may be oblique to a radial line from the axis of the shaft.

As the stirrer-blades gradually approach and then recede from the hearth at different points and leave the intermediate spaces untouched, it is desirable that provision be made whereby it is possible to reach all parts of the hearth and act upon all the material to be roasted. In order to accomplish this, it is necessary to give the blades a partial revolution before the beginning of a trip by hand or otherwise, so as to change their rotative position with reference to the points previously touched and also to make the paths of the blades either touch or overlap each other sidewise. The first requirement I meet by rolling the stirrer in one direction over the track and in an opposite direction over a different or partly-different track, which is either longer or shorter than the one first

mentioned, whereby the difference in the revolutions made by the supporting-wheels in rolling over these tracks of unequal lengths represents the angle to which the stirrer has been changed in its rotative position in making the round trip. For this purpose I provide the ends of the track with curved and therefore longer side tracks, rolling the stirrer in one direction over the main track and in the reverse direction over the side tracks. Automatic switching devices are provided, preferably in the form of spring-actuated switch-tongues, to accomplish the switching of the stirrer from the main to the side tracks in its reverse movement.

In the drawings, O indicates the tracks, which are preferably formed hollow, with openings at or near their treads in order that a cooling agent, such as air, may be forced therethrough to prevent undue warping. Track O, I will call the "main" track, which on one side is unbroken, while on the other it is interrupted by the introduction of four switch-tongues provided with springs, so that the automatic switching of the stirrer may be accomplished.

O′ indicates the side tracks, upon which by the arrangement of the switch-tongues shown in the drawings the stirrer passes upon its rearward movement.

In order to describe the automatic switching of the stirrer, I will refer to Fig. 3, in which the stirrer is shown as being located at the rear or feed end of the kiln. It will be remembered that the flanges on the supporting-wheels are arranged at the outside of the treads of said wheels in the construction I am describing and that when said wheels reach the first set of switch-tongues, (indicated by 1 and 1^a,) tongue 1 being open and tongue 1^a being closed by the action of their respective springs x and x', the supporting-wheels will retain their position on the main track and will continue to do so until they reach the tongues 2 and 2^a, the former being held closed and the latter being held open by their respective springs. The flange on the wheel at the left being the upper wheel shown in the drawings will force open the tongue 2, so as to permit its passage, while the flange on the lower wheel will close the tongue 2^a to prevent derailment. The arrangement of tongues 3 and 3^a is substantially the same as that of the tongues 1 and 1^a, and the action of the supporting-wheels with relation to these tongues is that described with reference to tongues 1 and 1^a. The action of the supporting-wheels with respect to tongues 4 and 4^a, being the last set of tongues encountered, is the same as that described with reference to the tongues 2 and 2^a. When the stirrer has passed the last set of switch-tongues, it has also passed the curtain E and is now in the cooling-chamber at the front end of the kiln, where it is permitted to remain for some length of time. The wheels having passed the switch-tongues 4 and 4^a, these switch-tongues will automatically return to their normal position, which is that shown in Fig. 3, and when the stirrer commences its rearward movement tongue 4 forces it laterally onto the side track, tongue 4^a being open for this purpose. The curve in the side track forces the stirrer to close the tongue 3 and open tongue 3^a, when the stirrer again rests on the main track until it reaches the next set of switches, when tongue 2 will force the stirrer onto the rearmost side track, whence by the curvature thereof at the rear end tongue 1^a will be opened and tongue 1 closed to permit the stirrer to pass again onto the main track to its original position, which is that in the cooling-chamber at the rear end of the kiln, said chamber being formed, as before described, by the curtain D and the rear end plate C.

I have heretofore mentioned that the charge is fed upon the hearth from the top through the opening *d*. The charge thus entering the kiln will of necessity accumulate immediately under the feed-opening, and in order to prevent the stirrer from pushing any of the fresh charge backward I raise the stirrer when it passes this point sufficiently high to clear the accumulated charge on the hearth. This is accomplished by elevating the side tracks at the rear end of the kiln, as shown at X, Figs. 2 and 3, which elevation of the side tracks occurs at a point immediately beneath the feed-opening. In passing from rear to front, as before described, the stirrer is on the main track and disturbs the accumulated charge under the feed-opening by pushing the same forward, meanwhile agitating the material. In its return movement the stirrer, having to take the side tracks, will be elevated by the raised side tracks at X, and thus does not disturb the accumulated charge under the feed-opening in its return movement, and at the same time I accomplish the prime object of these side tracks—that is, changing the rotative position of the stirrer-blades with respect to their starting-points.

I stated above that two elements were necessary to accomplish the thorough working of the charge on the hearth, one being to change the rotative position of the stirrer-blades with reference to their starting-point and the other being to make the paths of the blades either touch or overlap each other sidewise. I have described how I meet the first requirement, and I will now refer more in detail as to the manner of meeting the second.

As shown in the drawings, the zones of the several sets of blades on the shaft touch each other. It may be desirable in some instances to leave a space between the blade zones. In such a case the second requirement can readily be met by the use of two stirrers, in which the position of the blades in one would correspond with the spaces of the other. However, it is desirable to avoid duplication of parts, with their accompanying complication of details, and I therefore prefer to use only

one stirrer and run it forwardly and backwardly. The stirrer then is rolled first over the straight main track and back over the continuous side track. The blades as they dig into the charge during the forward movement push some of the material forwardly and longitudinally into holes, pits, or furrows dug by preceding blades. The material which is not separated as described is moved laterally into heaps or ridges between the paths of the blades. When the stirrer returns over the side track, the paths of the blades is in line with those heaps and ridges and the blades will move the material in them longitudinally into the holes, pits, and furrows and laterally into new heaps and furrows, these operations being repeated at every round trip.

In order to prevent the accumulation of the material on the sides of the hearth, the ends of the shaft are provided with solid heads N′, as shown more clearly in Fig. 6, on the inner faces of which heads are radial V-shaped blades whose working faces counteract this side accumulation and tend to turn the material toward the middle of the hearth.

The longitudinal movement communicated to some of the material by each blade I utilize to move the entire mass from the receiving to the discharge end of the kiln by making the blades move more material in one direction than the other. This I accomplish by making the blades concave on the front face, which is pushing the material toward the discharge end, and convex on the reverse or back face.

When the blades are rigidly attached to the shaft, as shown in the drawings, whose supporting-wheels roll forward and backward on, we will say, the same tracks, the wheels having a larger radii than the reach of the blades, I produce a gradual forward travel of the material by making the front of the blades concave or scoop-shaped and the back convex. In this construction the forward movement of the material toward the front or discharge end of the kiln is accomplished when the stirrer is moving forwardly, its reverse or rearward movement acting principally to laterally displace the material without imparting any great amount of longitudinal movement. For a wheel-radius smaller than the reach of the blades I make the blades also concave on the side facing the discharge end and pilot-shaped or convex in the rear, by which I accomplish in the movement of the stirrer from the feed end of the machine to the discharge end a lateral displacement, being what I would term a "back action," without imparting any great amount of longitudinal movement to the material toward the feed end of the kiln. However, when the stirrer is making its return movement—that is, moving toward the feed end of the kiln—this back action is utilized, due to the convexity of the blades, to move the material toward the discharge end of the kiln. This description of course is applicable only to the blades when they are on the under side of the axle and in their working position, it being understood that when the blades are idle and above the axle such position would be reversed.

On each end of the shaft are mounted boxes preferably containing runways in which balls may be introduced, so as to form antifriction-bearings for said boxes. These boxes, which I have lettered P, carry chains or traction-lines Q, which connect to endless chains R and R′, which are arranged in the chain-pits K on each side of the hearth. These endless chains I run at each end over sprockets r, which are driven by gears r', in turn connected with pinions s, mounted on a countershaft S. Shaft S may be driven by a belt running over a cone-pulley, as shown in Fig. 3, in order to obtain variable speeds for the different positions of stirrer in kiln—that is, fast speed when stirrer passes over hearth and slow speed when stirrer is at a standstill in cooling-chambers. By positively driving both chains R and R′, I obtain a parallel motion, which is necessary for the successful operation of the stirrer. The traction-line Q is preferably a chain, and, when motion is imparted to the endless chains R and R′, it will pull the stirrer forward and backward over the track, allowing the stirrer to stand still at the end of each trip until the point of the endless chain where the traction-line is fastened has traveled around the end sprocket and back to twice the reach of the traction-line. The stops in the motion of the stirrer take place beyond the end of the roasting-hearth proper and are utilized to cool the stirrer by the air entering through the openings in the end plates C. As shown in Figs. 1, 2, and 3, the stops in the travel of the stirrer occur so as to leave the stirrer in the cooling-chambers at the ends of the kiln outside the curtains D and E, respectively, where the stirrer is beyond the inlet of the fire or fuel gases and the outlet of the products of combustion and fumes from the charge and therefore beyond the limits of the heated central portion of the kiln. In order to keep the heat in the roasting zone of the kiln as much as possible away from the stirrer when it is at a standstill in the cooling-chambers, the partition walls or curtains D and E are provided. During the stops of the stirrer in these cooling-chambers it loses heat by radiation to the surrounding walls and by being in the path of the cool-air currents entering through the openings in the end plates C. I may also provide openings j in the walls and openings a' in the floor of the cooling-chambers, through which cool air from the exterior will enter by chimney-draft to cool the stirrer and support combustion over the hearth. It is obvious that if desired part of this air may be directed against certain parts of the stirrer, such as the joint between the

shaft and traction-line, as shown in Fig. 3. The cool air entering through the opening *j* strikes these joints.

In the preferred form of stirrer with a wheel radius larger than the reach of the blades the stirrer-track must of necessity be below the hearth, and this requires the provision of track-pits or wheel-pits on both sides of the hearth. These track-pits being partly protected from the heat of the fire-gases and the roof of the roasting-chamber are naturally the places for the towing-chains; but in order to still further remove the towing-chains from the source of heat I may extend these track-pits downward into the foundation of the roasting-kiln and therefore provide separate chain-pits not only below the level of the hearth, but also below the level of the stirrer-tracks. Near the bottom of the chain-pits I provide rollers or idlers *t* for the chains to roll over. I preferably make these rollers accessible and removable from the outside and also cool them by air-currents introduced by chimney-draft through openings in the roller frames or boxes, as shown at *u* in Fig. 4.

In Fig. 11 I have shown a slight modification in which the shaft M^a is made hollow, through which air or water may pass for the purpose of cooling the same. The ends of the shaft are provided with flanges to form the supporting-wheels N^a, which rest directly upon the side walls *a* of the hearth, which act as tracks, and thus economize space in the width of the kiln. The stirrer-blades N^b in this construction are in the form of paddles, their working faces being parallel with the shaft. In this construction it will also be noticed that the reach of the blades exceeds the periphery of the tread of the supporting-wheels.

I am aware that many minor changes in the construction, arrangement, and combination of the several parts of my roasting-kiln can be made and substituted for those herein shown and described without in the least departing from the nature and principle of my invention. It will of course be understood that such changes will be comprehended and included within the scope of the following claims.

Having thus described my invention, what I claim, and desire to secure by Letters Patent, is—

1. The combination with a hearth, of tracks arranged on each side thereof, wheels on said tracks, a shaft supported by said wheels and fixed to a least one of them, stirrer-blades arranged on and at an angle to the shaft, the reach of said blades being unequal to the radius of the tread of the wheels, sheaves arranged at each end of the hearth, an endless tow-chain on said sheaves, and a traction-line connected to the shaft, and to said tow-chain; substantially as described.

2. The combination with a hearth, of tracks arranged on each side thereof, wheels on said tracks, a shaft supported by said wheels and fixed to at least one of them, stirrer-blades arranged on and at an angle to the shaft, said stirrer-blades being concavo-convex in cross-section, the reach thereof being unequal to the radius of the tread of the wheels, and tow-lines connected directly to the ends of said shaft; substantially as described.

3. The combination with a hearth, of tracks arranged on each side thereof, wheels on said tracks, a shaft supported by said wheels, collars strung on said shaft, stirrer-blades extending outwardly from said collars, the reach of said blades being unequal to the radius of the tread of the wheels, sheaves arranged at each end of the hearth, an endless tow-chain on said sheaves, means for driving said tow-chain, and a traction-line connected to said tow-chain and to said shaft; substantially as described.

4. A stirrer having the following elements in combination: a shaft; wheels on the ends of the shaft; collars arranged on said shaft; and stirrer-blades projecting outwardly from said collars, the reach of said stirrer-blades being unequal to the radius of the tread of the wheels, the end collars being provided with solid flanges forming heads whose inner faces have raised ribs formed thereon, to provide inclined working faces, substantially as described.

5. In a roasting-kiln, the combination with a hearth, of tracks on each side of said hearth, wheels supported by said tracks, a shaft carried by the wheels, means attached to said shaft for causing its rotative travel over the hearth, and stirrer-blades arranged on and at an angle to said shaft, said stirrer-blades being concavo-convex in cross-section, and having a reach unequal to the tread of the supporting-wheels, whereby said blades laterally displace the material on the hearth while traveling in one direction, and move the material longitudinally the hearth while traveling in the opposite direction; substantially as described.

6. In a roasting-kiln, the combination with a hearth, of tracks arranged on each side thereof, a cylinder of radially-arranged stirrer-blades, which blades are cancavo-convex in cross-section, supporting-wheels for said cylinder, which wheels are mounted on said tracks, the radius of the tread of said wheels being unequal to the reach of said stirrer-blades, whereby, when said cylinder travels in one direction, the concave side of said blades force the material on the hearth longitudinally, and when said cylinder travels in an opposite direction the convex side of said blades laterally displace the material on the hearth, and tow-chains directly connected to the ends of said shaft for moving the same and its carried parts in opposite directions; substantially as described.

7. The combination with a hearth, of a stirrer comprising wheels, a shaft, stirrer-blades arranged on said shaft, tracks upon which said wheels are mounted, said tracks compris-

ing a main track, a side track, and suitable switching devices for transferring said wheels from the main to the side track, and vice versa; substantially as described.

8. The combination with a hearth, of a stirrer comprising wheels, a shaft, stirrer-blades mounted on said shaft, and tracks arranged on each side of said hearth for supporting said wheels, said tracks comprising a main track, a side track, and suitable switching devices for transferring said wheels from the main to the side track, and vice versa, said side track being elevated above the main track, so that, when the wheels run thereon, the stirrer will be elevated above the hearth, substantially as described.

9. The combination with a hearth, of a stirrer comprising supporting-wheels, a shaft, and stirrer-blades arranged on said shaft, a main track upon which said supporting-wheels run, one or more side tracks adjacent to said main track, and a spring-actuated switch-tongue for causing the travel of said supporting-wheels from the main to said side tracks, and vice versa; substantially as described.

10. In a roasting-kiln, the combination with the hearth, of a cylinder of stirrer-blades, means for causing the travel of said cylinder of stirrer-blades the length of said hearth, wheels for supporting said cylinder, tracks or runways for said wheels, and means in said tracks or runways for changing the rotative position of said cylinder of stirrer-blades while said stirrer is making a round trip, substantially as described.

11. In a roasting-kiln, the combination with the hearth, of a cylinder of stirrer-blades, means for causing the travel of said cylinder of stirrer-blades the length of said hearth, supporting-wheels for said cylinder, main tracks on which said supporting-wheels run, a plurality of side tracks, and switch-tongues for transferring said supporting-wheels from the main tracks to the side tracks, and vice versa, one of said side tracks being elevated above the main track, whereby the supporting-wheels of the stirrer travel over a greater length of track when moving in one direction than when moving in the other, thereby changing the rotative position of the cylinder of stirrer-blades during each round trip of the stirrer, substantially as described.

12. In a roasting-kiln, the combination with a hearth having tracks arranged on each side thereof, of wheels mounted on said tracks, a shaft mounted in said wheels and extending outwardly beyond the same, stirrer-blades carried by said shaft between the wheels, the reach of said blades being unequal the radius of the tread of the wheels, sheaves arranged at each end of the hearth, endless tow-chains on said sheaves on each side of said hearth and traction-lines attached to said tow-chains and connected to the projecting ends of the shaft on each side of the hearth; substantially as described.

13. The combination with a hearth having chain-pits arranged on each side thereof, of a stirrer mounted upon tracks arranged along each side of the hearth, said stirrer comprising supporting-wheels running on said tracks, a shaft, and suitable stirrer-blades, endless tow-chains in the chain-pits, and traction-lines attached to said endless chains and to the ends of the stirrer-shaft; substantially as described.

14. In a roasting-kiln, the combination with a hearth, of tracks arranged on each side thereof, chain-pits below the level of said tracks, a stirrer comprising wheels mounted on said tracks, a shaft, and suitable stirrer-blades arranged on said shaft, endless tow-chains arranged in said pits, sprockets or rollers mounted in the pits for supporting said chains, and traction-lines connecting the tow-chains with the end of the stirrer-shaft; substantially as described.

15. In a roasting-kiln, the combination with a hearth, of tracks arranged on each side thereof, a stirrer comprising supporting-wheels which run on said tracks, a shaft, and suitable stirrer-blades, endless tow-chains, suitable sprockets or rollers for said endless tow-chains, which sprockets or rollers are located beyond the ends of the hearth, traction-lines connecting the tow-chains with the ends of the shaft of the stirrer, and means for causing the travel of said tow-chains, whereby, when the traction-lines are connected to the chains above the sprockets or rollers, the stirrer travels in one direction, and when the connection of said traction-lines to the tow-chains passes under the sprockets, the stirrer travels in an opposite direction; substantially as described.

16. In a roasting-kiln, the combination with the side walls J and the roof B, of a hearth A, a stirrer above the hearth, curtain-walls depending from the roof beyond the ends of the hearth for forming cooling-chambers at each end of the kiln, and means for causing the travel of said stirrer over the hearth in both directions under the curtain-walls, and into the cooling-chamber at each end of the kiln where said stirrer rests before commencing its return movement; substantially as described.

17. The combination with the side walls and roof of a kiln, of a hearth, a stirrer above the hearth, traction-lines directly connected to said stirrer, endless tow-chains on each side of the hearth, to which said traction-lines are also connected, sheaves beyond each end of the hearth, and around which said tow-chains travel, and means for driving said tow-chains in unison; substantially as described.

18. The combination with the side walls and roof of a kiln, of a hearth, a stirrer above said hearth, endless tow-chains arranged on each side of the kiln, traction-lines connecting the stirrer to the tow-chains, sheaves arranged beyond the ends of the hearth, and around which the endless tow-chains travel, means for driving said tow-chains in unison, where-

by, when the points of connection between the traction-lines and tow-chains reverse their travel at each end of the kiln in passing around the sheaves, the stirrer rests until the traction-lines are taut in their reversed movement, and curtain walls or partitions near the ends of the kiln forming cooling-chambers at each end of the kiln, in which the stirrer rests while the traction-lines reverse their pull; substantially as described.

19. In a roasting-kiln, the combination with the side walls and roof, of a hearth, a charging-opening for depositing the material upon the rear end of the hearth, main tracks on each side of the hearth, on said main tracks a shaft, stirrer-blades arranged on said shaft, a raised side track adjacent to the main tracks at a point opposite the charge-opening, switch-tongues for causing the transfer of the wheels onto the lower main tracks in one direction to force the material toward the discharge end of the kiln, switch-tongues for causing the transfer of the stirrer onto the raised side track when said stirrer is traveling in an opposite direction, whereby said stirrer is elevated above the accumulated material under the charge-opening, and means for causing the travel of said stirrer, substantially as described.

20. In a roasting-kiln, the combination with the hearth, having track-pits arranged on each side thereof, tracks in said pits, supporting-wheels on said tracks, a shaft fixed in said supporting-wheels, and stirrer-blades arranged on said shaft, whose reach is less than the radius of the tread of said supporting-wheels, substantially as described.

JOHN ZELLWEGER.

Witnesses:
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