No. 797,584. PATENTED AUG. 22, 1905.

C. E. KEATING.

ORE ROASTING FURNACE.

APPLICATION FILED MAR. 31, 1905.

2 SHEETS—SHEET 1.

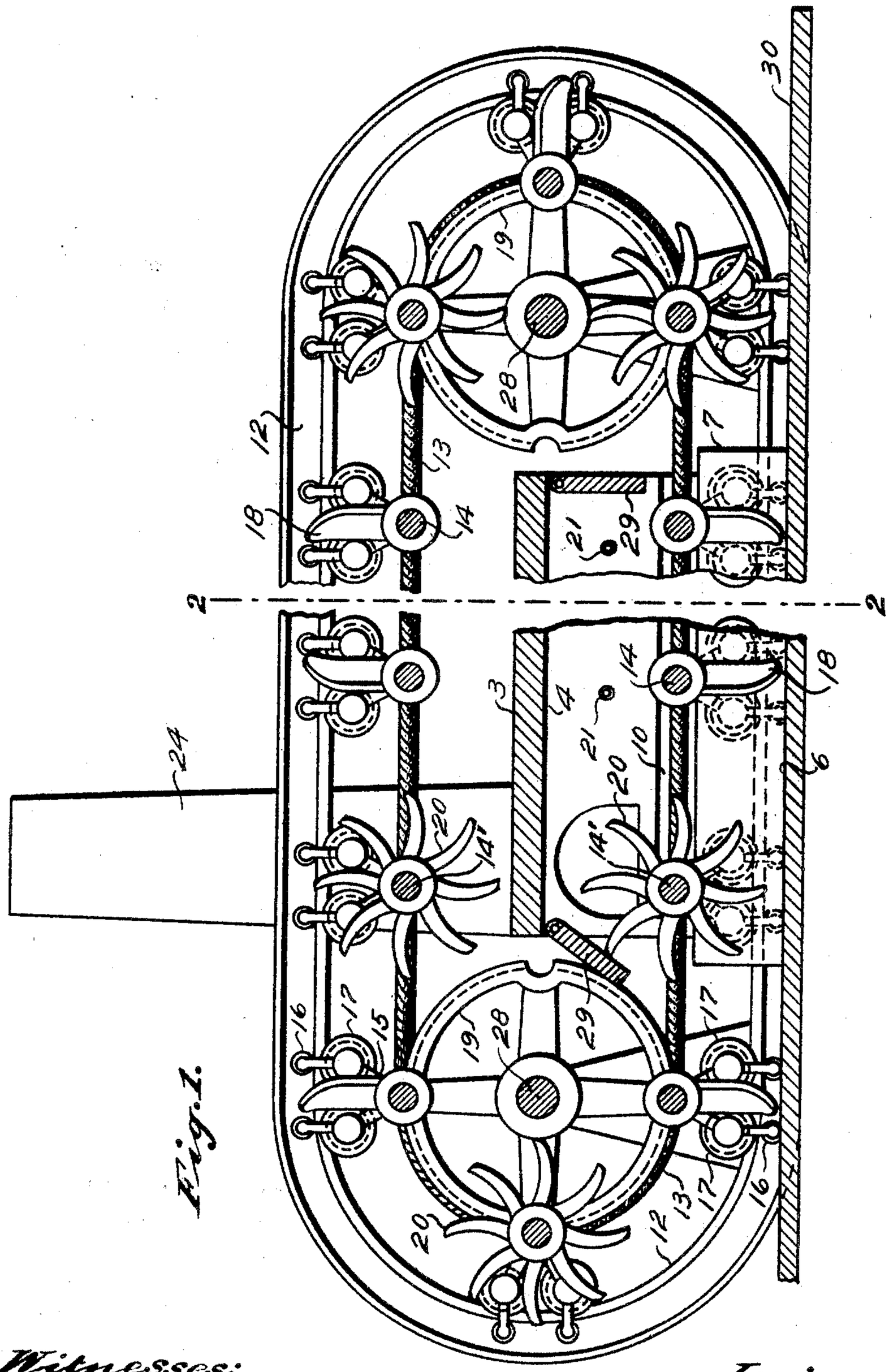

Fig. 1.

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2 SHEETS—SHEET 2.

Fig. 3.

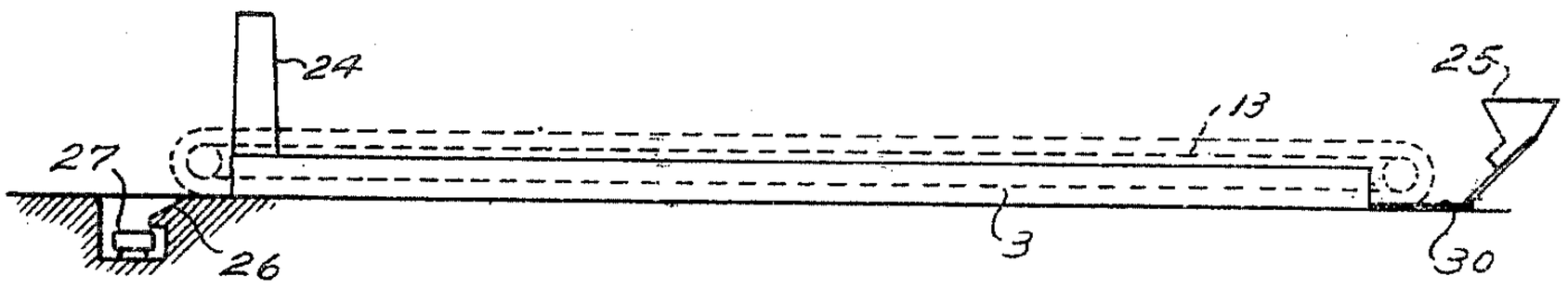
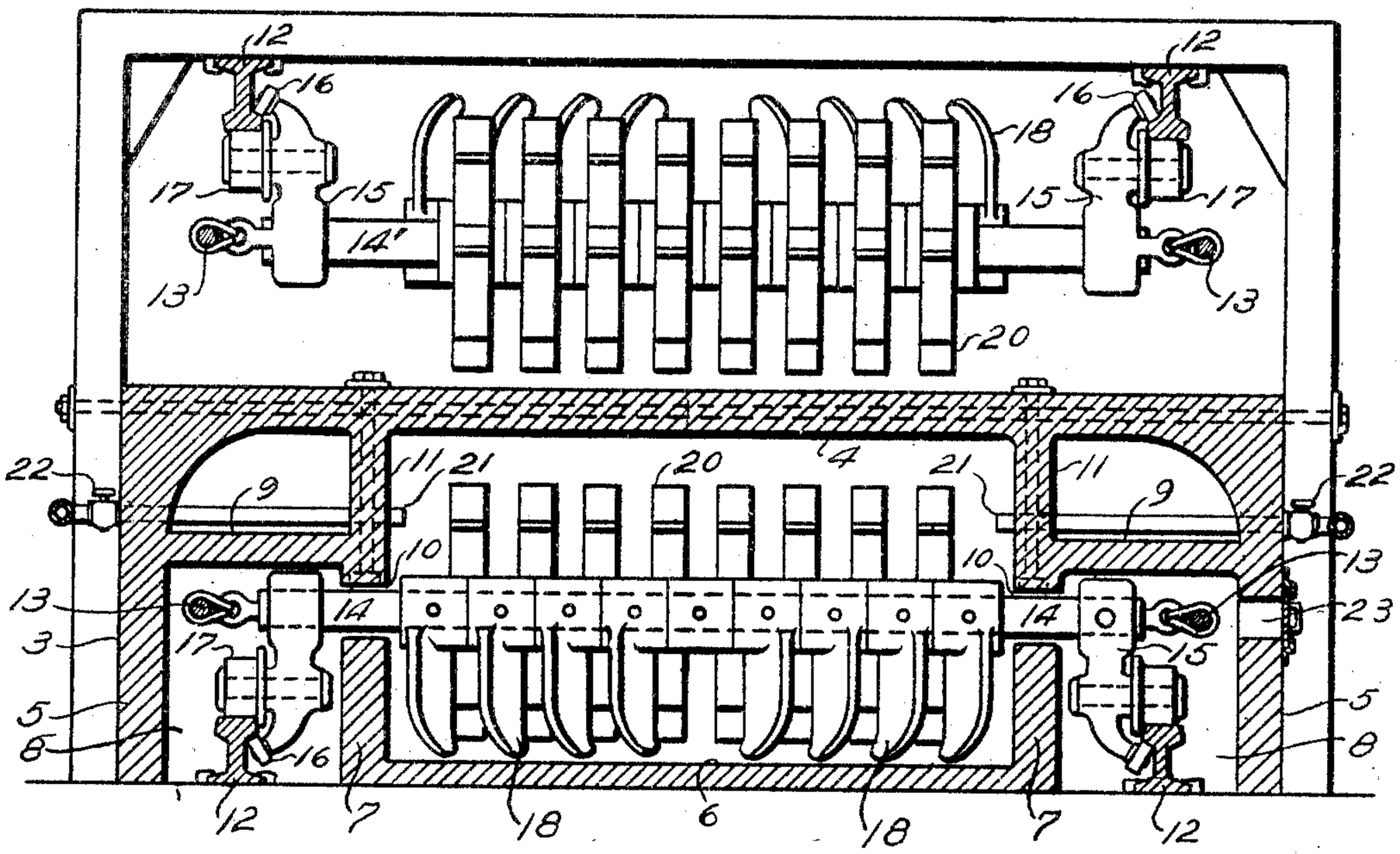


Fig. 2.



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UNITED STATES PATENT OFFICE.

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ORE-ROASTING FURNACE.

No. 797,584. Specification of Letters Patent. Patented Aug. 22, 1905.

Application filed March 31, 1905. Serial No. 253,152.

To all whom it may concern.

Be it known that I, CHARLES EMMET KEATING, a citizen of the United States of America, and a resident of East Chicago, in the county of Lake and State of Indiana, have invented certain new and useful Improvements in Ore-Roasting Furnaces, of which the following is a specification.

This invention relates to the class of furnaces which are used for roasting ore for the purpose of removing sulfur therefrom.

The main objects of this invention are to provide an improved form of continuously-operating ore-roasting furnace which at a minimum expense of operation will thoroughly roast all of the ore that is passed through the same; to provide an improved form of conveyer for moving the ore along the hearth; to provide means for protecting the conveyer mechanism from the heat of the furnace, and thereby avoiding breakages and the necessity of stoppage for the purpose of repair, and to provide an improved form of stirring apparatus for agitating the ore. I accomplish these objects by the device shown in the accompanying drawings, in which—

Figure 1 is a vertical longitudinal section of an ore-roasting furnace constructed according to my invention, a considerable part intermediate of the ends of the furnace being broken away and some of the supporting-framework for the conveyer mechanism being also omitted for the sake of clearness of the drawing. Fig. 2 is a transverse section on the line 2 2 of Fig. 1. Fig. 3 is a side elevation on a greatly-reduced scale, showing the general arrangement of the structure.

In the construction shown in the drawings the kiln 3 consists of a fire-brick structure and is comparatively low in height and of great length. The roof 4 of the structure arches over the outer side walls 5 to form a long tubular passage open at each end. The middle part of the inclosure forms a hearth 6, which is trough-shaped and extends throughout the entire length of the kiln. Low walls 7 form the sides of the hearth and extend from end to end of the kiln, being spaced away from the walls 5 to form a passage or tunnel 8 at each side of the hearth. The passages 8 are covered by a shelf 9, which is supported from the roof of the structure so as to leave an unobstructed opening 10 between the top of the wall 7 and the inner edge of said shelf. It is also preferred to connect the inner edges of the shelves 9 with the roof by a wall 11, so as to contract as much as possible the free space above the hearth.

An endless track 12 extends longitudinally through each of the passages 8 and over the furnace, as is illustrated in Fig. 1. Each of the tunnels 8 also has an endless belt 13, such as a cable or chain, extending in parallel relation with the tracks 12. These belts are carried by suitable sheaves 19 at the ends of the furnace and are connected together by a plurality of transverse beams or shafts 14. The ends of the shafts 14 are fastened to the belts 13 against shifting longitudinally thereof and are supported at each end by a carriage 15, which rides on the respective rail 12. Each carriage 15 is also provided with guide-rollers 16, bearing on the lower side of the head of the rail. These guide-rollers 16 hold the wheels 17 of the carriage 15 down upon the tread of the track and also serve to support the shafts 14 when in positions above the top of the furnace.

Each of the shafts 14 and 14′ is provided with a row of stirring devices which extend down close to the bottom of the hearth 6. On alternate shafts 14 the stirring devices consist of plow-shaped arms or blades 18, which are adapted to turn the ore which rests on the hearth into furrows when such stirring devices are drawn along the hearth. The shafts 14, which carry the plow-blades, are rigidly secured against rotation in their supports on the carriages. The arms 18 at each side of the longitudinal center line of the hearth tend to turn the material toward the center line. The next succeeding set of plow-arms tends to turn the ore away from the center and to form new furrows in the ore. These arms besides turning the ore also have a tendency to move the ore gradually in a forward direction through the furnace. The stirring members on the shafts 14′, between the shafts 14, consist of star-shaped members 20, having radially-disposed curved arms. These shafts are loosely journaled on their carriages and rotate when the members 20 are dragged through the ore. The members are so shaped as to lift and tend to break any crust which forms on the surface of the ore, and thus assist the arms 18 in thoroughly stirring the ore so as to expose all parts of it to the heat of the furnace. The curvature of the arms of the members 20

is such that said arms when rotated through being drawn along tend to enter endwise into the upper surface of the mass of ore on the hearth, to pass below the crust, and then lift edgewise out of the same, breaking and overturning the crust. To permit this rotation, the shafts 14′ are not directly connected with the belts 13; but the belts are connected to a yoke on the carriages.

In the form of furnace which is shown in the drawings the heating of the interior of the kiln is effected by means of gas-flames, burners 21 being located at suitable intervals along the length of the kiln. These burners are controlled by valves 22, which may be operated from the outside of the furnace. Additional heat is also furnished by the burning of the sulfur from the ore. The necessary air for the combustion of the gas and sulfur is taken from the passages 8 and enters through the openings 10, thus causing a draft from the pasages 8 toward the hearth of the kiln, and thereby preventing the heat of the hearth from affecting the cables and bearings of the carriages of the conveyer.

The passages 8, besides being open at their ends to admit air, are also provided with air-inlet apertures 23 at proper intervals along the length of the kiln. These apertures are controlled by sliding doors, which may be manipulated by the operator.

The burned gases are carried off by a chimney 24 near one end of the kiln, and the gas-flames within the kiln are so arranged that the heat to which the ore is subjected gradually increases in intensity from the inlet toward the delivery end of the kiln. The floor of the hearth is extended beyond each end of the kiln. The green ore is delivered to a point near the inlet end by means of a hopper 25 and is discharged at the outlet end upon an inclined chute 26, from which it is delivered to the cars 27.

The flanges of the sheaves 19 are recessed to receive the connections between the cables 13 and the ends of the shafts 14, and the conveyer is driven by mechanism connected with one of the shafts 28, which carry the sheaves 19. This driving mechanism is not shown in the drawings. The ends of the kiln are closed above the conveyer by means of swinging doors 29. These doors swing to permit the passage of the stirring devices, but are normally closed to prevent unnecessary rushing in of cold air.

The operation of the device shown is as follows: The green ore after having been properly crushed is delivered to the floor 30, which is a continuation of the floor of the hearth 6. The stirring devices of the conveyer then engage the ore and gradually drag the same into the kiln. The speed of the conveyer and the spacing of the stirring devices are such that succeeding stirring devices pass the same spot about once every minute. As the stirring devices pass through the ore besides throwing the ore toward one side they also have a tendency to drag the ore in a forward direction. This dragging effect should be such that the ore will consume sufficient time in passing through the entire length of the furnace to insure driving off the proper amount of sulfur from the ore. It would usually require an exposure to the heat of the furnace for about ten hours.

Since the furnace is continuous in its operation after the gas-flames have once been properly started and properly adjusted, the furnace will continue in operation for indefinite periods with little attention. The fact that all of the wearing parts are either on the outside of the kiln or in the passages 8, which are constantly cooled by the inrushing cold air, prevents such wearing parts from being affected by the heat of the furnace. These parts are consequently long-lived and there is little liklihood of their becoming out of repair. Oiling and similar attentions can be given to the parts during their passage on the outside of the kiln.

It will be seen that numerous details of the construction shown may be altered without departing from the spirit of my invention.

What I claim as my invention, and desire to secure by Letters Patent, is—

1. In a device of the class described, the combination of a horizontally-disposed furnace, having a hearth extending longitudinally of the same; a conveyer extending along said hearth from end to end and carrying a succession of alternate sets of relatively fixed and rotating stirring devices, said fixed devices being adapted to enter the mass of material resting on the hearth and turn the same into longitudinal furrows, and said rotating devices having arms adapted to enter the mass of material and roll in a longitudinal direction, for preventing a crust from forming on the surface of the material, substantially as described.

2. In a device of the class described, the combination of a horizontally-disposed hearth for supporting a layer of material to be roasted, a track extending along each side of said hearth, a shaft extending across the hearth and supported by wheels riding on said tracks, a plurality of stirring devices mounted on said shaft and rotatable about the axis thereof, said stirring devices having radially-disposed arms and being adapted to rotate through engagement with the material on said hearth for stirring the same, said arms being curved in a radial direction whereby the rotation of said stirring devices when said shaft is moved along the hearth will cause said arms to pass endwise into the mass of the material on the hearth and be lifted edgewise therefrom, and means for moving said shaft along the hearth.

3. In a device of the class described, the

combination of a horizontally-disposed hearth, a longitudinal passage extending along each side of said hearth and separated therefrom by a slotted partition, a track extending along each of said passages, a carriage mounted on each of said tracks, a shaft extending across the hearth through said slotted partitions and journaled in said carriages, a plurality of stirring devices rigidly mounted on said shaft and having radially-disposed arms, said devices being adapted to rotate through engagement with the material on said hearth for stirring the same, and means for moving said carriages along the hearth.

Signed at Chicago this 10th day of March, 1905.

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