No. 794,837. PATENTED JULY 18, 1905.

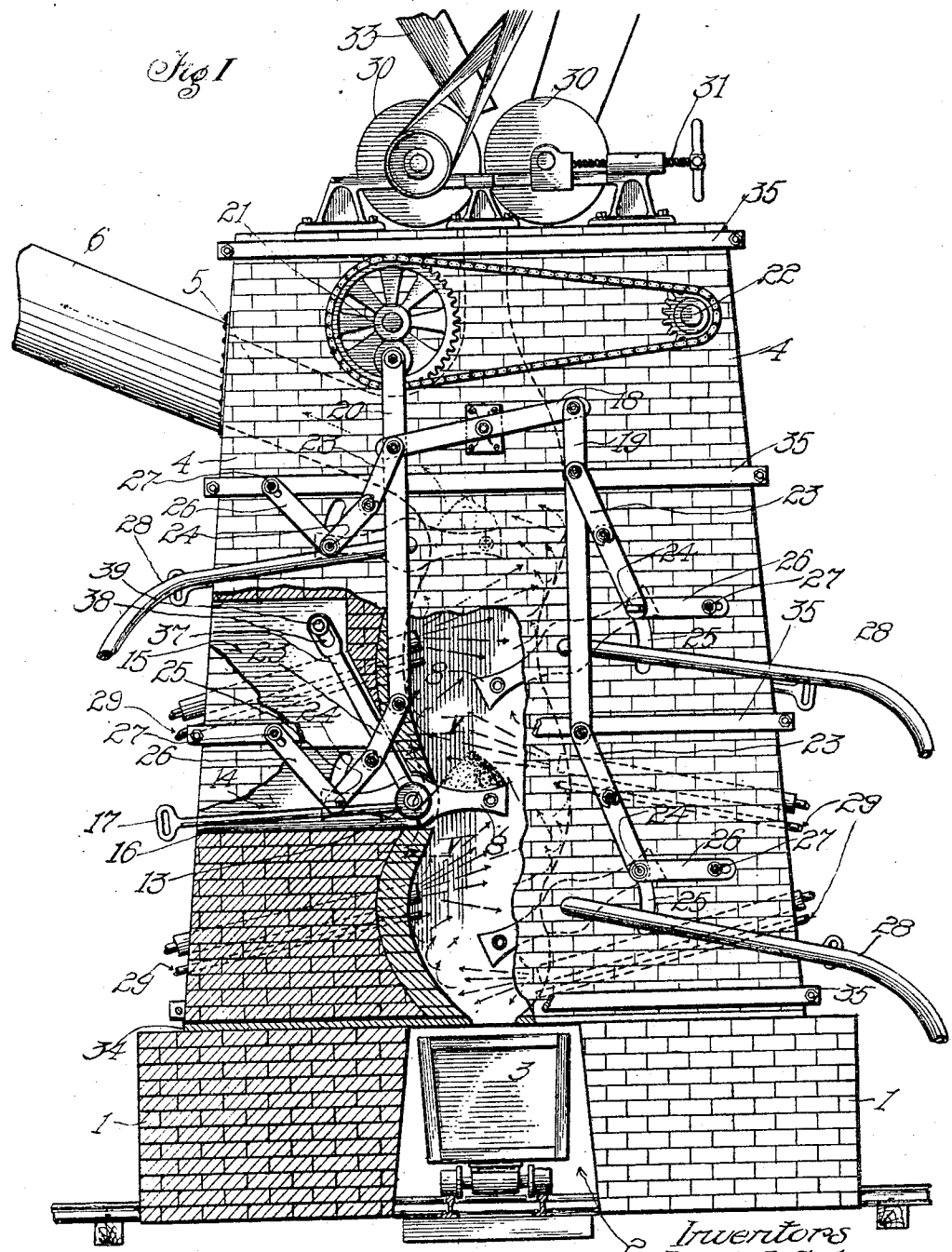
J. A. ANKER, J. H. WATSON & P. EVANS.

ROASTING FURNACE.

APPLICATION FILED DEC. 10, 1903.

4 SHEETS—SHEET 1

Fig I



Witnesses
Samuel Fied
G. T. Hackley

Inventors
Joseph A. Anker
James H. Watson
Pierce Evans

by Townsend Bros.
Attys

ANDREW B. GRAHAM CO., PHOTO-LITHOGRAPHERS, WASHINGTON, D. C.

No. 794,837. PATENTED JULY 18, 1905.

J. A. ANKER, J. H. WATSON & P. EVANS.

ROASTING FURNACE.

APPLICATION FILED DEC. 10, 1903.

4 SHEETS—SHEET 2.

Fig. II

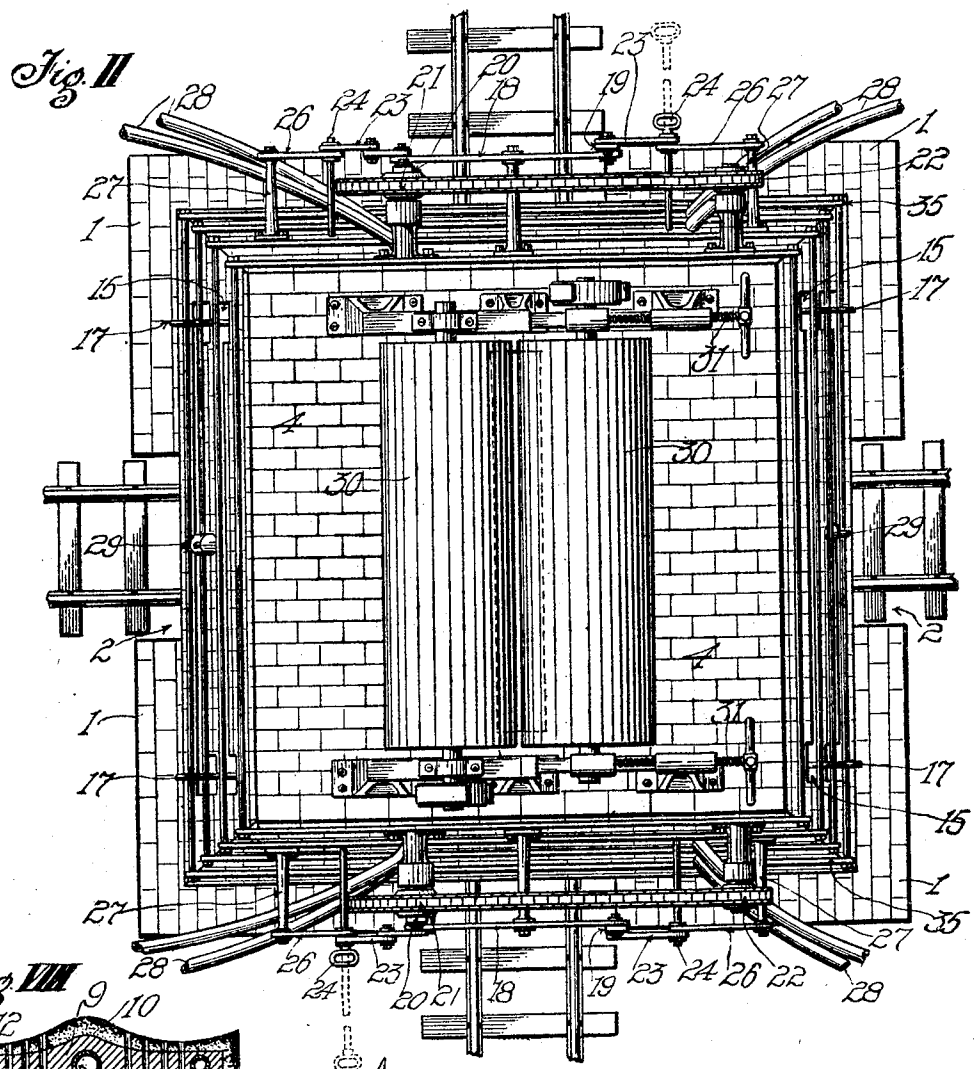


Fig. VIII

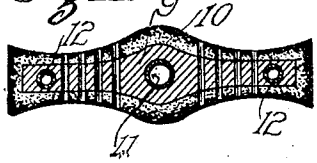
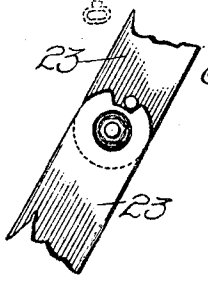


Fig. IX



Witnesses
Samuel Fiel
G. T. Hackley

Inventors
Joseph A. Anker
James H. Watson
Pierce Evans
by Townsend Bros.
Attys

ANDREW B. GRAHAM CO. PHOTO-LITHOGRAPHERS, WASHINGTON, D. C.

No. 794,837. PATENTED JULY 18, 1905.

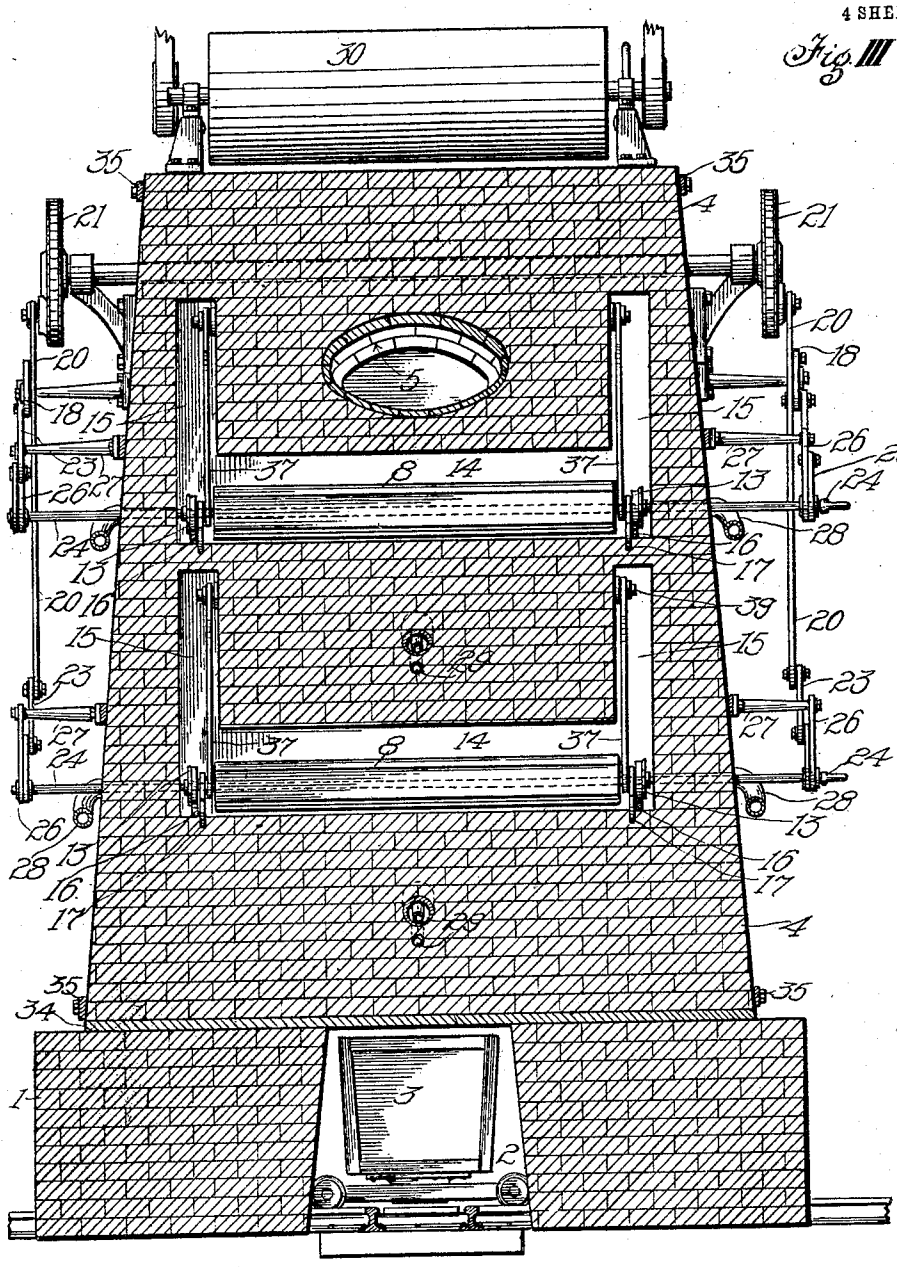
J. A. ANKER, J. H. WATSON & P. EVANS.

ROASTING FURNACE.

APPLICATION FILED DEC. 10, 1903.

4 SHEETS—SHEET 3.

Fig. III



Witnesses
Jamesfield
G. T. Hackley

Inventors
Joseph A. Anker
James H. Watson
Pierce Evans
by Townsend Bros.
Attys

ANDREW B. GRAHAM CO., PHOTO-LITHOGRAPHERS, WASHINGTON, D. C.

No. 794,837. PATENTED JULY 18, 1905.

J. A. ANKER, J. H. WATSON & P. EVANS.

ROASTING FURNACE.

APPLICATION FILED DEC. 10, 1903.

4 SHEETS—SHEET 4.

Fig. IV

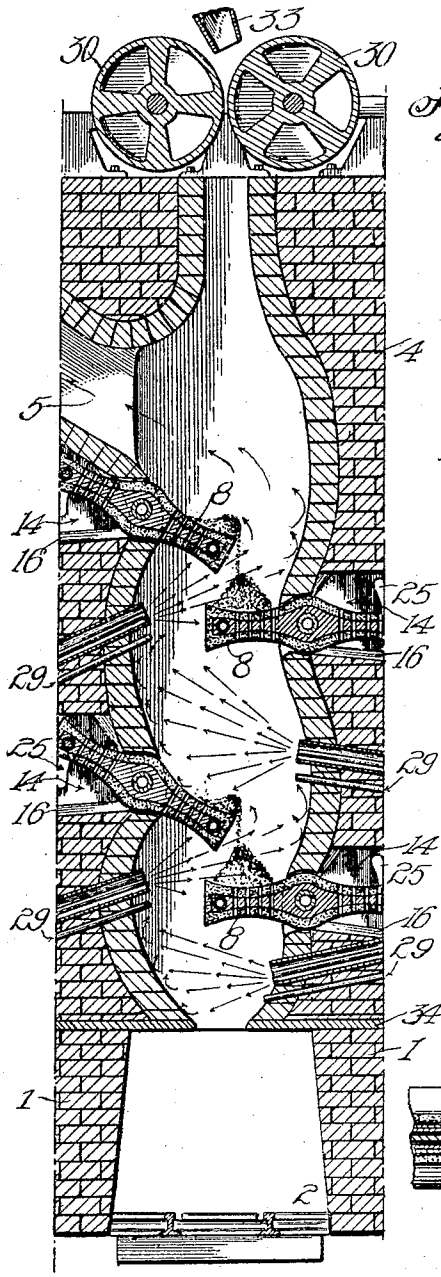


Fig. V

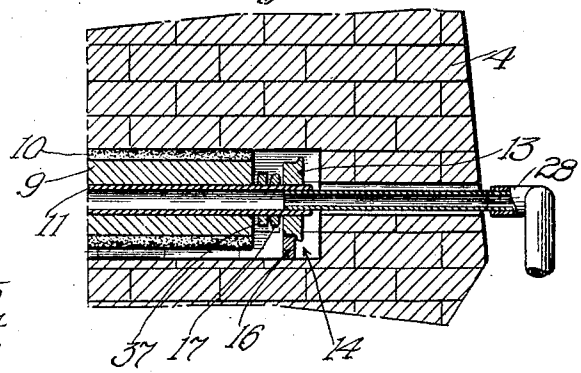


Fig. VI

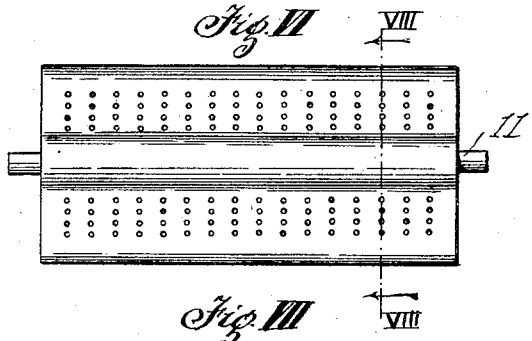
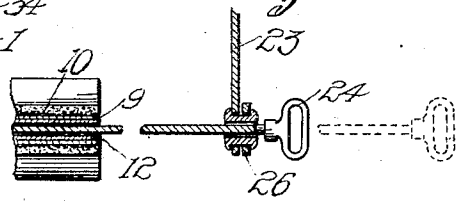


Fig. III



Witnesses
Thomas Fiel
Q. T. Hackley

Inventors
Joseph A. Anker
James H. Watson
Pierce Evans
by Townsend Bros.
attys.

ANDREW B. GRAHAM CO., LITHOGRAPHERS, WASHINGTON, D. C.

No. 794,837. Patented July 18, 1905.

UNITED STATES PATENT OFFICE.

JOSEPH A. ANKER, JAMES H. WATSON, AND PIERCE EVANS, OF LOS ANGELES, CALIFORNIA; SAID ANKER AND EVANS ASSIGNORS TO SAID WATSON.

ROASTING-FURNACE.

SPECIFICATION forming part of Letters Patent No. 794,837, dated July 18, 1905.

Application filed December 10, 1903. Serial No. 184,574.

To all whom it may concern:

Be it known that we, JOSEPH A. ANKER, JAMES H. WATSON, and PIERCE EVANS, citizens of the United States, and residents of Los Angeles, in the county of Los Angeles and State of California, have invented a new and useful Roasting-Furnace, of which the following is a specification.

This invention relates especially to a furnace designed for roasting ore.

The main object of this invention is to provide a furnace which is so constructed that the ore is projected in a thin stream or veil through a chamber, so that the stream of ore receives the direct action of a flame and air-blast.

Another object of the invention is to provide means for controlling the passage of the ore through the chamber.

Another object is to provide means whereby an air-blast may be introduced into the chamber, so as to promote a perfect roasting of the ore by driving off fumes and arsenical or other properties in the ore.

Another object is to produce a furnace of the character described in which the control of the passage of the ore through the chamber is effected automatically.

Another object is to provide means for the automatic handling of the ore during its passage through the furnace and delivery therefrom and to provide means whereby the roasted ore may be taken away from the furnace with the least amount of labor.

Another object is to provide a roasting-chamber of a novel form, which by its contour will deflect the flames during their passage up the chamber, causing them to pulsate, which greatly augments their action upon the ore.

Another object is to provide novel means in the form of retaining-shoes for controlling the passage of ore through the chamber, which may be utilized to the utmost extent and which are susceptible of being reversed or changed in position, so that when one part of the shoe becomes worn or otherwise unfit for use another part may be brought into place.

Another object is to provide means for preventing excessive heating of the retaining-shoes, which control the passage of the ore through the chamber.

Another object is to provide means whereby the said fuel-controlling means or retaining-shoes may be expeditiously removed from operative position in the furnace for replacement or readjustment.

Other objects of the invention are to produce a furnace which may be constructed within a relatively small compass compared to other roasting-furnaces, but which will have a capacity and efficiency equal to or greater than any other roasting-furnace of which we are aware.

Other objects are to provide a furnace which is simple in construction, economical in working, and durable in use.

The accompanying drawings illustrate the invention, and referring to the same, Figure I is a side elevation of the furnace, the lower left-hand portion of the side wall being broken away. Only the spout of the hopper for feeding the crushed ore to the furnace is shown. Fig. II is a plan view of the furnace with the hopper removed. Fig. III is a rear elevation of the furnace. Fig. IV is a vertical section taken through that portion of the furnace contiguous the roasting-chamber. Fig. V is a section on line V V of Fig. I. Fig. VI is a plan view of a retaining-shoe. Fig. VII is a detail showing a locking-bar for the retaining-shoe. The means which support the locking-bar are shown in section. The dotted lines indicate the outward position of the locking-bar. Fig. VIII is a section on line VIII VIII of Fig. VI. Fig. IX is a detail of the jointed ends of the links.

1 designates a base structure of masonry, which has cross-cuts 2, in which tracks are provided for cars 3 for receiving the ore after being treated. The furnace proper is built upon the base 1 and preferably constructed of brick walls 4, the cross-section of which is preferably square in outline. A sinuous roasting-chamber is formed vertically through the center of the furnace, being relatively restricted in space between the curved faces and being relatively wide between the flat walls.

The upper end of the chamber is constricted at the point where the ore is admitted, and its lower end is also constricted at the point where the ore is delivered. A gallery or flue 5 branches from the chamber at the upper portion thereof at an incline and leads to a stack or flue extension 6. The walls of the sinuous roasting-chamber are preferably lined with fire-brick, as shown. Projecting from the convex portions or promontories of the walls of the sinuous chamber are retaining-shoes 8, which are to catch a falling stream of ore and retain the same in a mass and then deliver the mass gradually in a thin stream, as described hereinafter in the operation. Each shoe is made double and reversible—that is, it has right and left symmetrical portions, with symmetrical upper and lower faces preferably concave, as shown. Referring more particularly to Fig. VIII, each shoe comprises a central core of metal, such as cast-iron, 9, which has a covering or shell of fire-clay 10. Passing longitudinally through the center of each shoe is a hollow shaft 11, and passing longitudinally through the cast-iron core near each end is a tubular rod 12. The tubular shaft 11 is extended somewhat beyond the ends of the shoe and carries wheels 13. (See Fig. III.) The front and back walls of the furnace are provided with horizontal recesses 14, which have branch vertical slots or recesses 15. Rails 16 are mounted at the bottom of the recesses 15 and are slightly inclined, and the wheels 13 rest upon the rails 16. Suitable rods 17 are attached loosely to the ends of the tubular shafts 11 and extend back through the slots 15, being provided with exposed handles whereby a shoe may be withdrawn when desired, the wheels rolling along the rails.

A walking-beam 18 is provided on each side of the furnace near the upper end, and each walking-beam has connected to its ends rods 19.

20 is a rod which connects the walking-beam to a crank-pin of a sprocket-gear 21, which is mounted on the outside of the furnace and driven by chain from a pinion 22, the pinion 22 being driven from any suitable source of power.

In the present embodiment we have shown four shoes for the sinuous chamber, two shoes being arranged on each side and the shoes of one set being staggered with the shoes of the other set. The lower ends of the rods 19 and 20 are connected with toggle-levers 23. The toggle-levers 23 are constructed as shown in Fig. IX, so that the two members have only a limited flexibility at the joint with respect to each other.

24 designates rods, one of which is provided for each shoe, its outer end having a handle, as shown in Fig. VII, and each rod passes through the perforated end of a toggle 23 and through the adjacent tube 12 of a shoe, thus hinging the shoe to its respective toggle-levers. Curved shoes 25 are formed through the wall of the furnace concentric with the respective axes of the shoes, and the rods 24 slide through the curved slots 25 when the shoes are rocked. Links 26 are provided, which are connected with the toggle-levers by thimbles *a* (see Fig. VII) and have their ends slotted to play over studs 27. The rods 24 pass through the thimbles *a*. The function of the links 26 is to make a smoother motion of the toggles and actuating mechanism and also to take off some of the strain from the axes of the shoes. The length of the slot in the end of the links 26 is sufficiently great to allow for the travel of the rods 24.

37 represents rods having slotted ends 38, which receive studs 39, their other ends being connected to the tubular axes 11 of the shoes. The slotted ends allow of the withdrawal of the shoes a certain distance and prevent the accidental dropping of the shoes when removing them.

The upper shoes of each set are connected to the rods 19 by similar toggle-levers, as shown, and are also connected with links similar to the links 26, just described.

In order to prevent excessive heating of the retaining-shoes, a cooling agent—such, for instance, as brine—may be circulated through the tubular axes of the shoes and may be conducted thereto by pipes 28.

In the present embodiment we have provided four oil-burners, which project their flames from opposite walls of the sinuous chamber, and each oil-burner projects its flame underneath a shoe. An air-blast is also introduced into the chamber underneath each burner through a pipe 29. This air-blast forms no part of the burner, being entirely extraneous of the burner and is introduced not to necessarily promote the action of the burner, although incidentally it does so, but to create a chemical reaction upon the ore, as will be hereinafter described, and we consider this air-blast as an important feature of the invention, and it should not be confounded with oil-burners which, considered *per se*, may introduce some air with the flame.

A pair of feed-regulating mills 30 are mounted on the upper end of the furnace, and the space between them may be regulated by any suitable means—such, for instance, as the screws 31, which control the position of slidable journals 32, in which one of the mills is mounted.

33 designates the spout of a hopper which delivers the ore between the mills.

In order to firmly support the side walls of the furnace, iron beams 34 are extended across the base 1, and in order to secure and retain and brace the walls of the furnace braces or tie-bars 35 are employed.

The operation is as follows: Crushed ore is fed through the spout 33 between the mills 30,

the mills 30 being spaced apart only a slight distance preferably to give a stream of ore one-eighth inch thick or thereabout, and the ore issues in a thin stream or veil down through the constricted upper portion of the chamber and strikes upon the uppermost shoe. If the uppermost shoe is in a horizontal position, the stream of ore will collect upon the shoe, and as the stream of ore drops down the flame passing up from the flue is projected through the film or veil of ore, is brought into immediate contact therewith and attacks the same, and ignites the sulfur and the arsenical or other properties which are to be eliminated. The strong air-blast also drives against the film and forces out the fumes and also works through the perforated shoe and in driving up through the mass of ore which has collected upon the shoe clears the mass of fumes or sulfur or other elements to be removed. Owing to the sinuosity of the chamber and the presence of the projecting shoes, the flames in their passage up the chamber are deflected many times back and forth, oscillating the flames and giving them a pulsation, so that when they strike the ore they envelop the same, and although having a general direction through the ore one way the flames attack the ore on both sides. The sulfurous fumes and other gases which are liberated are driven by the air-blast up through the flue and dissipated. After a certain amount of ore has been fed in a stream onto the first shoe and has received its initial heating the shoe is tilted from its horizontal position to a depressed position, as shown in Fig. IV, and simultaneously with this movement of the shoe the other shoes partake of relative movements, the shoes on the opposite or front side of the chamber being brought to horizontal position when the shoes on the back side are tilted into an inclined position.

What we claim is—

1. In a roasting-furnace, a roasting-chamber having sinuous walls and a series of perforated retaining-shoes pivotally mounted and projecting into the chamber, and means for moving the retaining-shoes.

2. In a roasting-furnace, a vertical sinuous chamber, a plurality of retaining-shoes projecting into the chamber, said shoes being arranged in two sets, and automatic means for bringing one set to a horizontal position and simultaneously inclining the shoes of the other set.

3. In a roasting-furnace, a vertical sinuous chamber, a plurality of retaining-shoes projecting into the chamber, each retaining-shoe having symmetrical portions; a tubular shaft extending longitudinally through the shoe, wheels on the ends of the shaft; the walls of the furnace having a recess, inclined rails at the bottom of the recess, said wheels resting on said rails; and means for rocking said shoes.

4. In a roasting-furnace, a retaining-shoe comprising double symmetrical portions, each portion having symmetrical upper and lower concave faces, said shoe comprising a metal core and a covering of infusible material.

5. In a roasting-furnace, a retaining-shoe comprising double symmetrical portions, each portion having symmetrical upper and lower concave faces, said shoe comprising a metal core and a covering of infusible material, said shoe having vertical perforations.

6. In a roasting-furnace, a vertical chamber, pivoted reversible double retaining-shoes projecting into the chamber, and means for controlling the retaining-shoes.

7. In a roasting-furnace, a vertical sinuous chamber open at both ends, retaining-shoes projecting into the chamber, a flue branching from the upper part of the chamber under the respective shoes, oil-burners discharging under the respective shoes, and air-blast pipes discharging into the chamber under the respective burners.

8. In a roasting-furnace, a vertical sinuous chamber, open at both ends, a set of retaining-shoes pivotally mounted and projecting into the chamber from one side, another set of similarly-mounted retaining-shoes projecting into the chamber from the opposite side, the shoes on one side being staggered from those on the other side, a walking-beam on the wall of the furnace, connections from the walking-beam to the respective retaining-shoes, and means for actuating the walking-beam.

9. In a roasting-furnace, a vertical sinuous chamber, open at both ends, a set of retaining-shoes pivotally mounted and projecting into the chamber from one side, another set of similarly-mounted retaining-shoes projecting into the chamber from the opposite side, the shoes on one side being staggered from those on the other side, a walking-beam on the wall of the furnace, connections from the walking-beam to the respective retaining-shoes, and means for actuating the walking-beam, the walls of the furnace having curved slots, concentric with the pivotal axis of the retaining-shoes.

In testimony whereof we have signed our names to this specification, in the presence of two subscribing witnesses, at Los Angeles, in the county of Los Angeles and State of California, this 21st day of November, 1903.

JOSEPH A. ANKER.
JAMES H. WATSON.
PIERCE EVANS.

Witnesses:
GEORGE T. HACKLEY,
FREDERICK S. LYONS.