No. 789,952. PATENTED MAY 16, 1905.

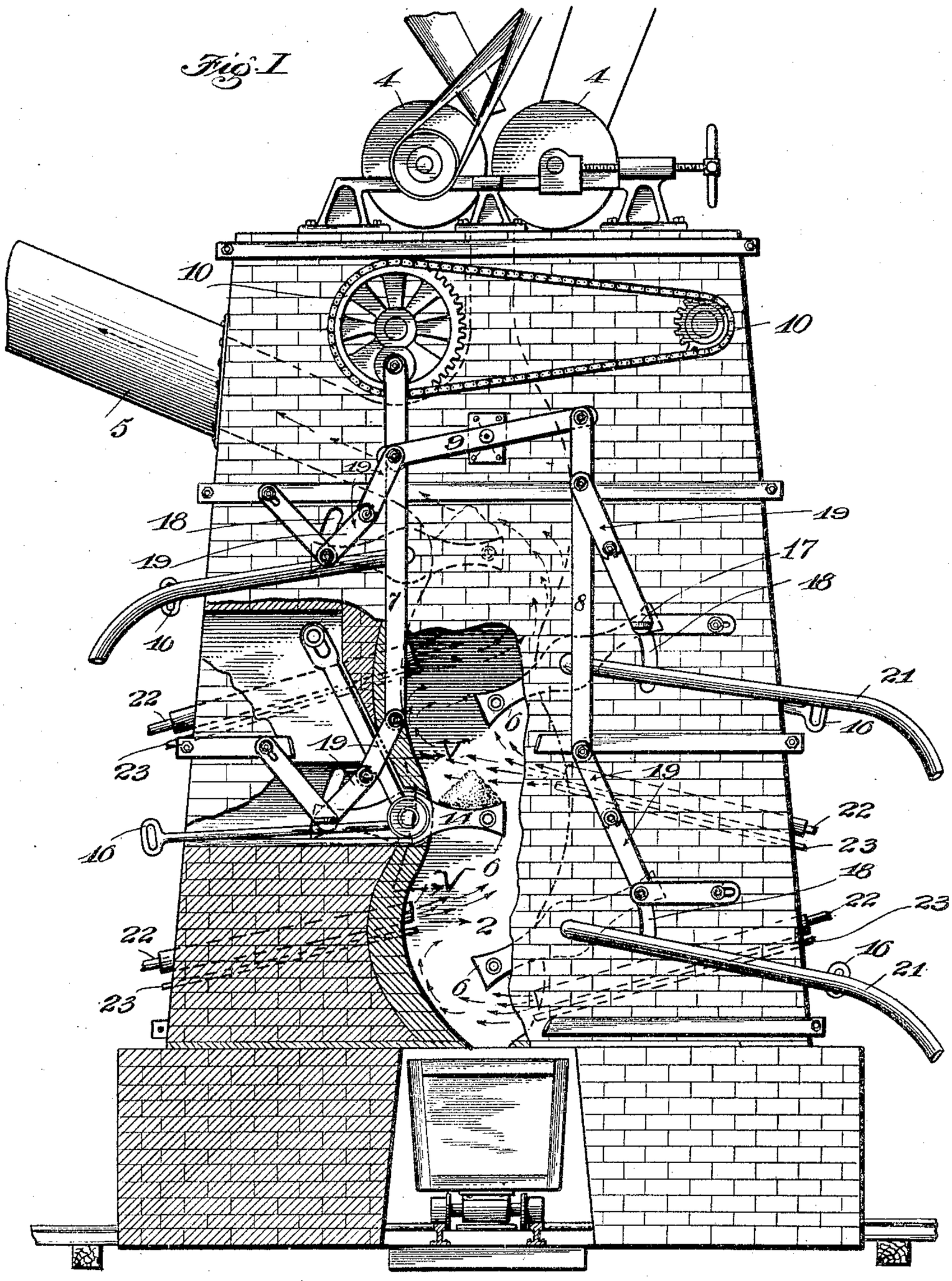
J. A. ANKER, J. H. WATSON & P. EVANS.

PROCESS OF ROASTING ORES.

APPLICATION FILED DEC. 10, 1903.

4 SHEETS—SHEET 1.

Fig. 1



WITNESSES

Edmund A. Strauss.

G. T. Hackley

INVENTORS

JOSEPH A. ANKER

JAMES H. WATSON

PIERCE EVANS

by Townsend Bros

attys

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4 SHEETS—SHEET 2.

Fig. II

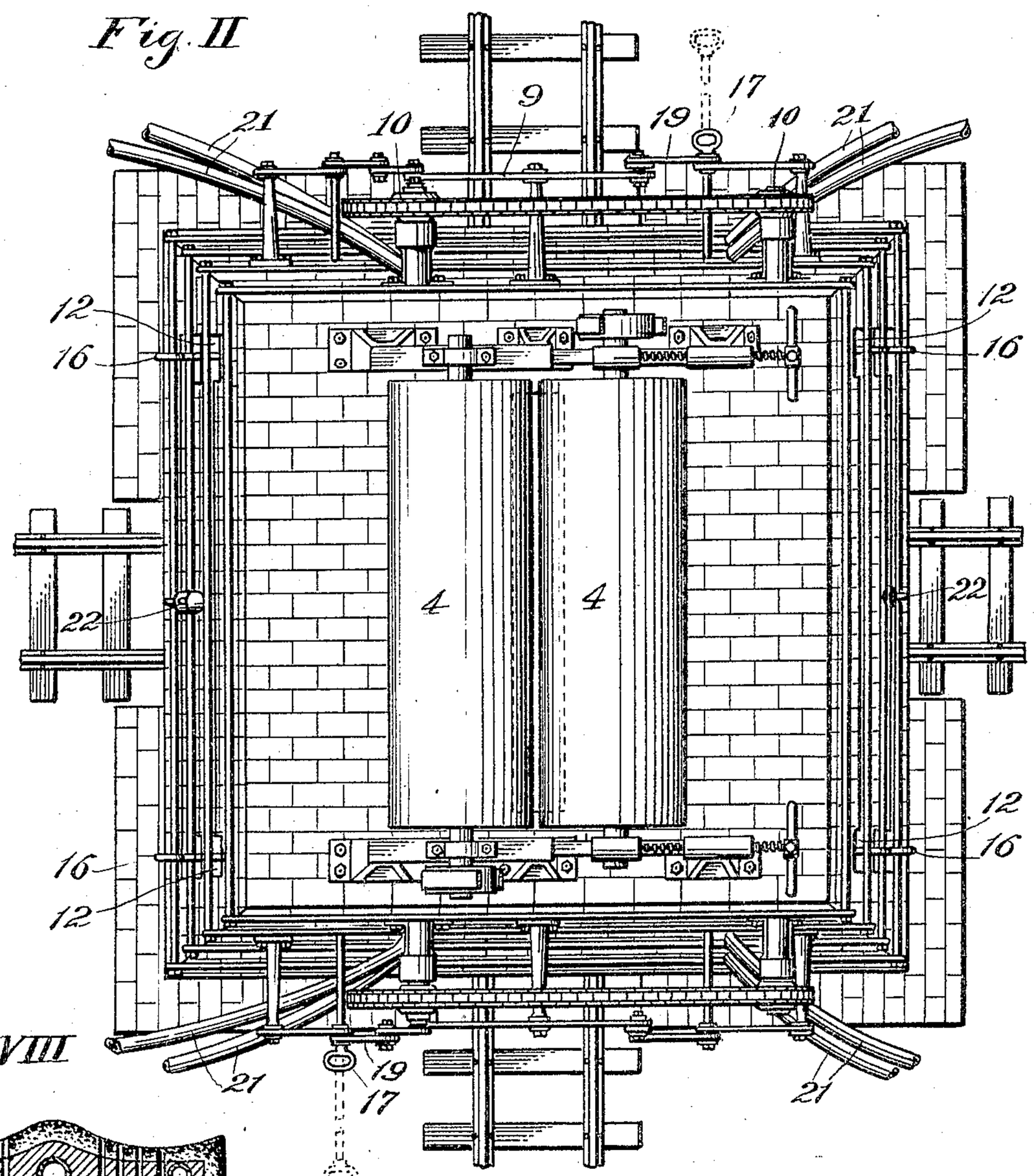
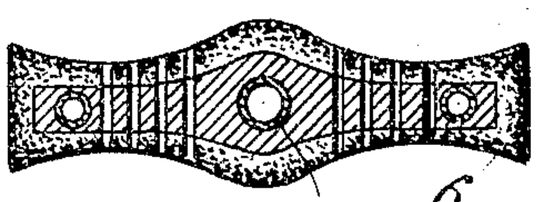


Fig. VIII



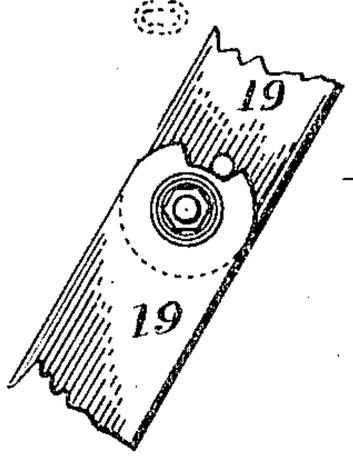


Fig. IX

Witnesses:
C. C. Holly
G. T. Hackley

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

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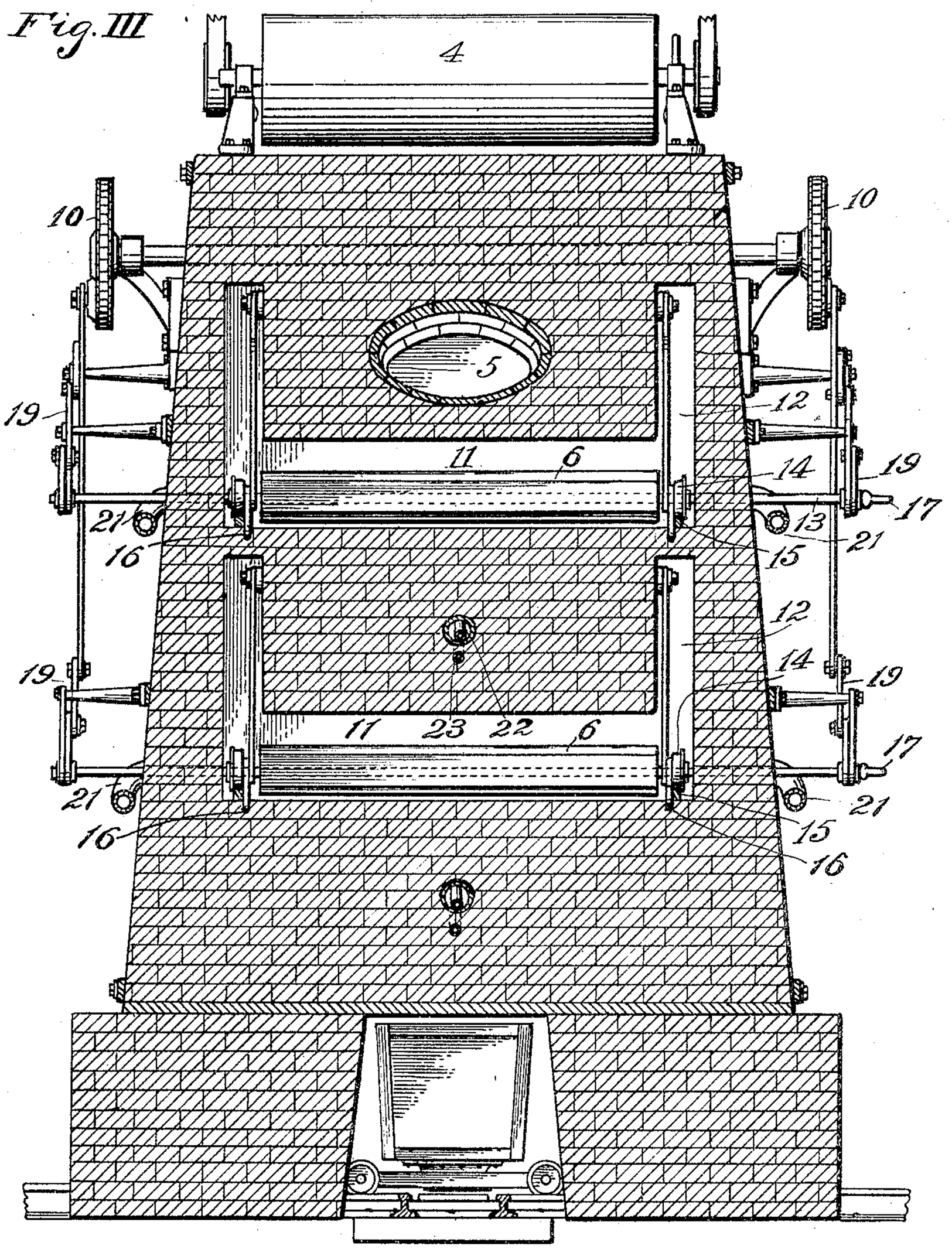
4 SHEETS—SHEET 3.

Fig. III



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4 SHEETS—SHEET 4.

Fig. IV

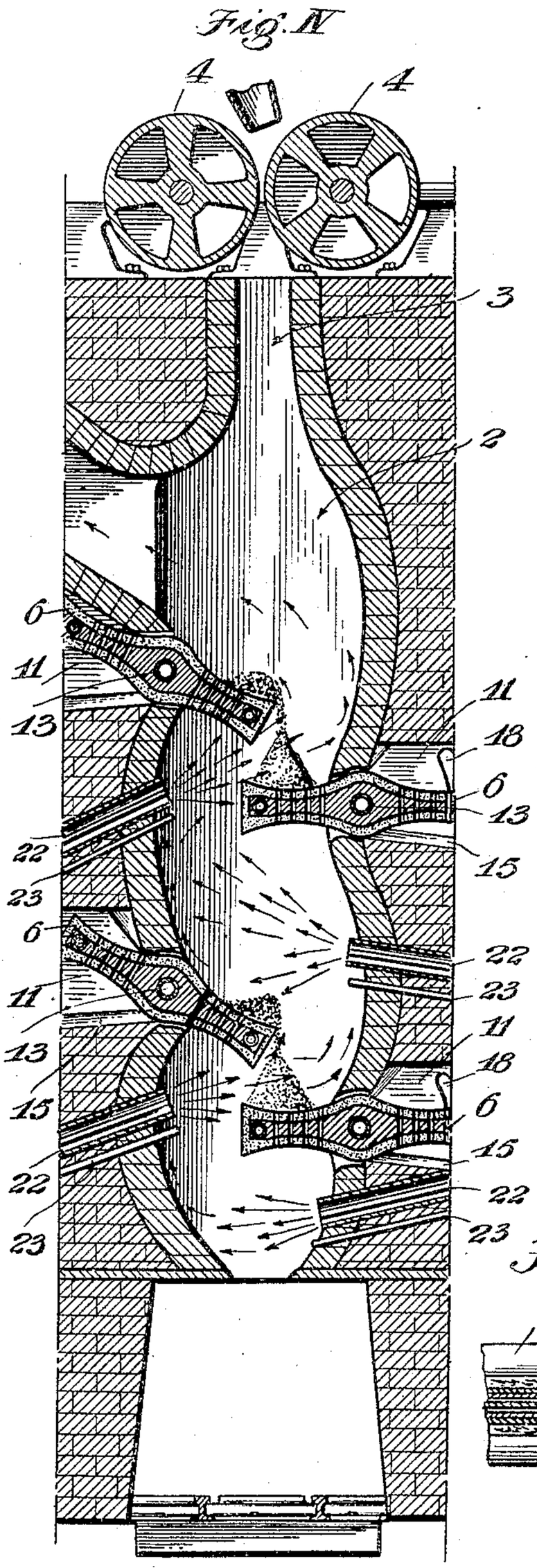


Fig. V

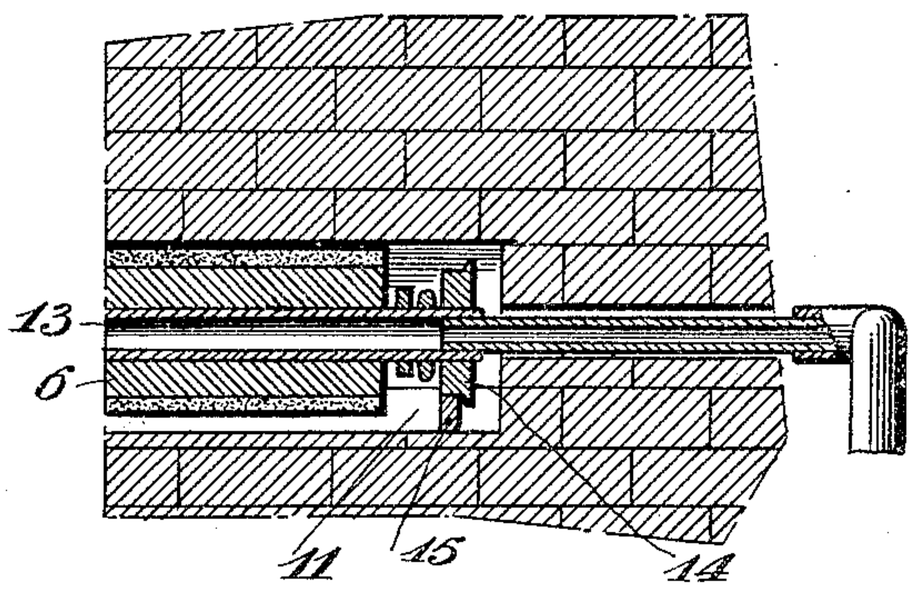


Fig. VI

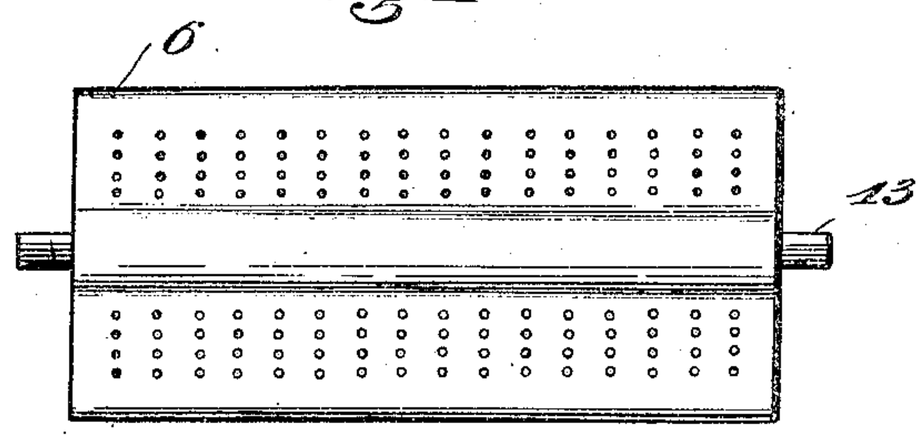
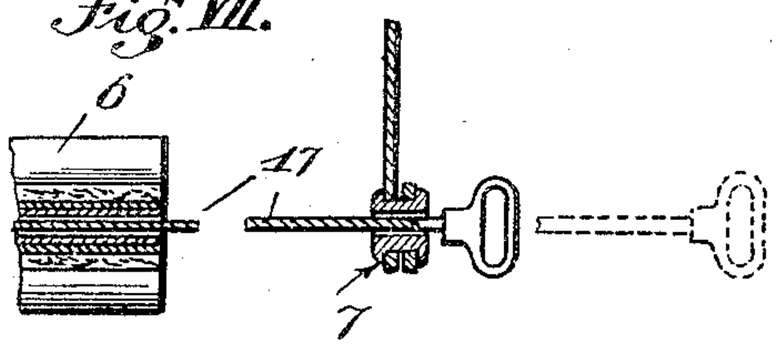


Fig. VII.



INVENTORS
JOSEPH A. ANKER
JAMES H. WATSON
PIERCE EVANS

WITNESSES
Sammy A. Straus.
G. T. Hackley

by Townsend Bros
attys.

No. 789,952. Patented May 16, 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.

PROCESS OF ROASTING ORES.

SPECIFICATION forming part of Letters Patent No. 789,952, dated May 16, 1905.

Application filed December 10, 1903. Serial No. 184,575.

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, residing at Los Angeles, in the county of Los Angeles and State of California, have invented a new and useful Process of Roasting Ores, of which the following is a specification.

This invention relates to the process of roasting ore, particularly copper ore, and has for its object to render the process more expeditious and considerably cheaper.

Broadly the present process consists of projecting the ore in a thin stream or veil and projecting a flame against or through the veil.

More specifically the process consists of dropping the crushed ore in a thin stream or veil down a vertical tortuous chamber by stages, the downcoming stream being intercepted, so that the falling ore accumulates in a mass, which is held stationary for a short time and then discharged through another stage down the chamber, again arrested and held stationary, and again discharged in a thin stream down the chamber, and so on. Flames produced, preferably, by oil-burners are introduced into the chamber, and these flames pass up through the chamber and are given a pulsating character by being continually deflected in their passage up the chamber, and the flames passing through the veil of falling ore envelop and attack it, igniting the sulfur in the ore and releasing the arsenical or other elements which are to be eliminated preparatory to smelting. The falling of the ore in a stream continues for a definite interval, and the ore is accumulated in segregated masses. The segregated masses are then respectively discharged and allowed to pass in thin streams farther down the chamber.

The life of the flames is continuous during the carrying out of the process; but the action of the flames on the ore varies according as the ore is segregated in masses or falling in streams. The action of the flames against the ore when in a mass gives a preliminary heating preparatory to a more complete action and separation of the sulfur and other elements, which will take place when the ore is again projected in streams.

Simultaneously with the introduction of flames to the ore an air-blast is introduced into the chamber, which, although it unites with the flame and promotes combustion somewhat, is not introduced for that reason, but for the purpose of giving a strong blast against the ore to prevent the formation of any crust or collection of any moisture on the ore, the air-blast blowing out the fumes and preventing adhesion of ore to any part of the furnace.

The flames on entering the chamber immediately attack and envelop the ore, igniting the sulfur and releasing the arsenical or other properties from the ore. The expansion of the flame and deflection takes place immediately in front of and around the gases at the point where they undergo combustion. The deflection of the flame gives it a pulsatory action, which gives it great activity upon the ore and secures a maximum of efficiency with a given amount of fuel.

Various forms of apparatus may be devised for carrying out this process, and the accompanying drawings illustrate one form of apparatus which may be used for the purpose.

Inasmuch as the apparatus shown forms the subject-matter of another application of ours, filed December 10, 1903, Serial No. 184,574, and is fully described and claimed in the said application, only a brief description of the apparatus will be here given.

Referring to the drawings, Figure I is a side elevation of the apparatus with the lower left-hand portion of the wall broken away to show the interior. Fig. II is a plan view of the apparatus. Fig. III is a back view of the apparatus. Fig. IV is a vertical sectional view of that portion of the furnace which is in the immediate vicinity of the roasting-chamber. Fig. V is a sectional view on line V V, Fig. I. Fig. VI is a plan view of a retaining-shoe. Fig. VII is a broken sectional view of a shoe-locking bar and the locking-

bar support. Fig. VIII is a transverse vertical sectional view of a retaining-shoe. Fig. IX is a detail view of a portion of the jointed ends of the links.

The furnace is preferably square in cross-section, being built up of brick, and is provided with a substantially vertical tortuous or sinuous roasting-chamber 2, which is lined with fire-brick. The opposite curved faces of the tortuous chamber lie relatively close together, while the width of the chamber is much greater. The upper end of the chamber is constricted to a narrow opening 3, through which the ore is introduced from between mills 4, which may be adjusted to regulate the thickness of the stream of ore admitted. The bottom of the chamber is constricted, so as to discharge the ore in a stream into a car which may be run under the chamber. The upper end of the chamber 2 branches into a flue communicating with the stack 5.

From the bulging portions or promontories of the tortuous chamber shoes 6 project, which are pivotally mounted and adapted to be rocked between a horizontal position and an inclined position by means of levers 7 and 8. The shoes 6 are constructed with symmetrical right and left parts and upper and lower faces, so that when one face has become worn the shoe may be turned over or reversed to give a fresh face for receiving the ore. Thus each shoe is provided with four faces, which may be utilized one after the other as the wear upon the shoe necessitates. In the embodiment shown we have provided four shoes, two projecting from each side of the chamber, the shoes on both sides being operated by similar mechanisms and the mechanisms being so arranged and connected by a walking-beam 9 that when one set of shoes is horizontal the other set is depressed. While one set of shoes is being moved from the horizontal position to the depressed position the other set of shoes is being raised to the horizontal position.

Suitable gearing 10 is provided for driving the mechanism. By referring to Fig. III it will be seen that the front and back walls of the furnaces are provided with horizontal recesses 11, which have branch vertical recesses 12. The shoes 6 are mounted on hollow shafts 13, which are carried by wheels 14, the wheels 14 riding upon rails 15, which lie in the lower part of the vertical slots 12. The shoes may be drawn out by means of rods 16.

In order to keep the shoes in place, rods 17 are provided, which pass through the links 7 and through curved slots 18 in the wall of the furnace, the rods 17 working in the curved slots when the mechanism is operated. These rods 17 may be withdrawn, as indicated by dotted lines in Fig. II, when it is desired to run the shoes out to turn them over. Short links 19 are also provided, which act as stops when the shoes are in either extreme position. In order to prevent excessive heating of the shoes, brine or other cooling agent may be circulated through the hollow axles by means of pipes 21.

Underneath each shoe oil-burners 22 are provided, and under each oil-burner an air-blast is introduced through a pipe 23. It should be understood that the air-blast which enters through the pipe 23 does not form part of the oil-burner, but is entirely extraneous to the oil-burner and is employed to secure a chemical reaction on the ore and not to affect the operation of the burner in any way.

In operation the ore is fed down between the rolls 4, the same being adjusted to secure a thin stream, preferably of about an eighth of an inch thick. This stream of ore falls during its initial stage down the chamber upon the first or uppermost horizontal shoe and gradually accumulates in a mass thereon. As the stream or veil of ore falls the flames rising through the furnace pass through the stream and envelop the ore, attacking the same and igniting the sulfur and releasing the arsenical or other properties. The air-blast which comes through the pipes 23 drives off the sulfur fumes and is a very important feature of the invention, as without the air-blast there would be an incrustation upon the mass of ore as the ore accumulates on the shoe, and the air-blast obviates such accumulation. The air-blast also drives out any moisture which might be on the ore. After a quantity of ore has accumulated on the first shoe the shoe is tilted by the rotation of the gearing and the mass of ore which had accumulated on the shoe is caused to fall in a thin stream or veil from the first shoe onto the next lower shoe, which in the meantime has raised to a horizontal position, and during the passage of the ore from the first to the second shoe it is acted upon further by the flames in a manner similar to that just described. After the mass has accumulated on the second shoe the shoes are again shifted, so that the ore falls in a thin stream from the second shoe to the third shoe, where it is further acted upon directly by the immediate contact of the flame and air-blast and is further freed from sulfur and arsenical or other properties, and from the third shoe the mass is delivered to the fourth shoe in due time in a thin stream, as before, being again acted upon by the direct flame, and from the fourth shoe, after having accumulated thereon in a mass, the ore is fed in a thin stream into the car, being again acted upon by the flame from the lowest oil-burner as it falls in a thin stream into the car. The shoes are provided with perforations, as shown in Fig. VI, for the purpose of permitting the blast to pass therethrough to prevent adhesion of the mass to the shoe, the blast keeping the perforations entirely clean.

What we claim is—

The process of roasting ore which consists of introducing separate flames into a suitable chamber at various points, passing ore through the furnace past the flames, and alternately accumulating the ore in heaps between the flames and then slowly dumping the heaps to gradually deplete the heaps and drop the ore in several thin streams, the respective streams being actively attacked by, and receiving intimate contact with the respective flames; and introducing air-blasts into the chamber simultaneously at various points to secure the same chemical reaction upon all of the heaps or streams of ore.

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. LYON.