(No Model.) 2 Sheets—Sheet 1.

P. NAEF.

FURNACE FOR ROASTING ORES.

No. 528,016. Patented Oct. 23, 1894.

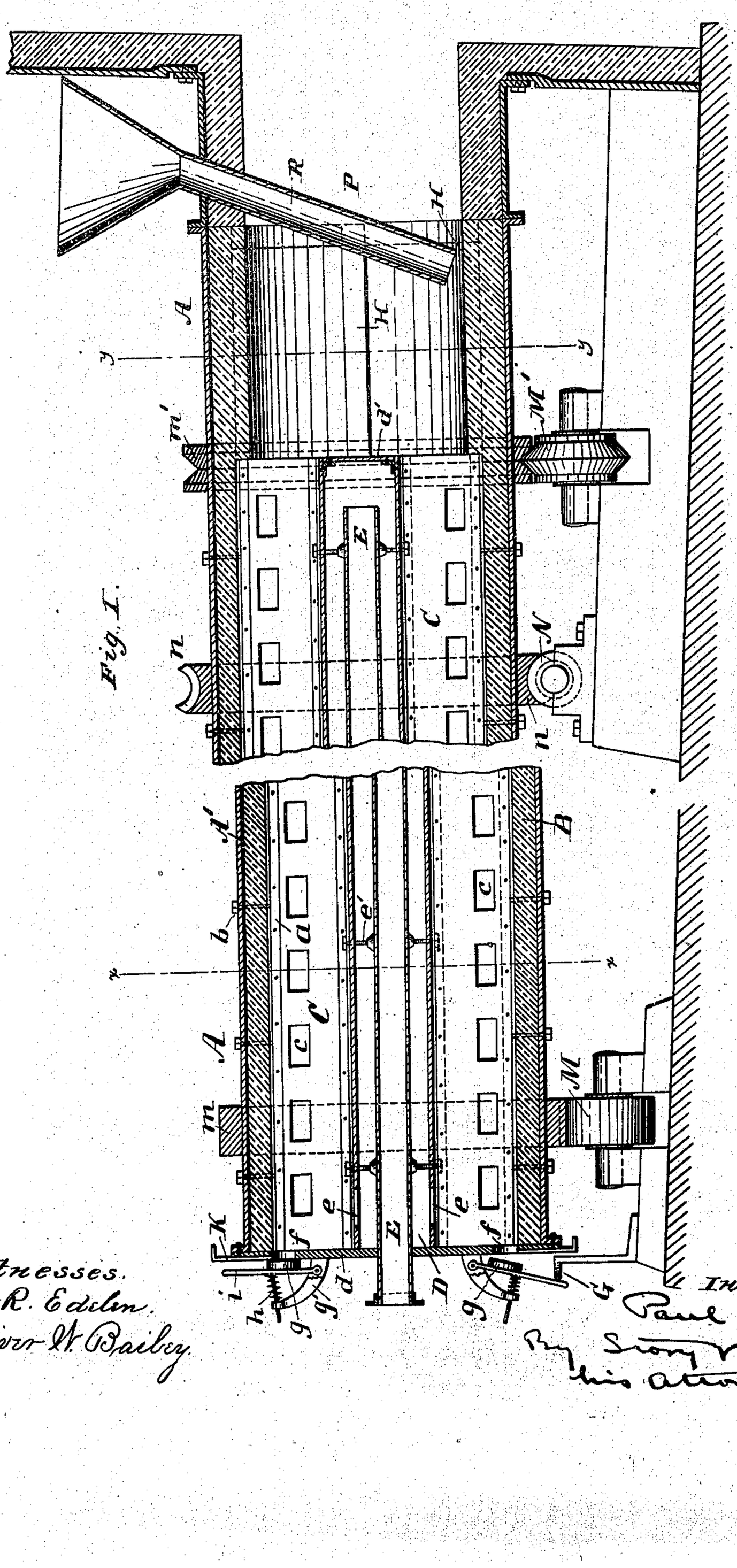

Fig. 1.

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(No Model.) 2 Sheets—Sheet 2.

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Fig. 2.

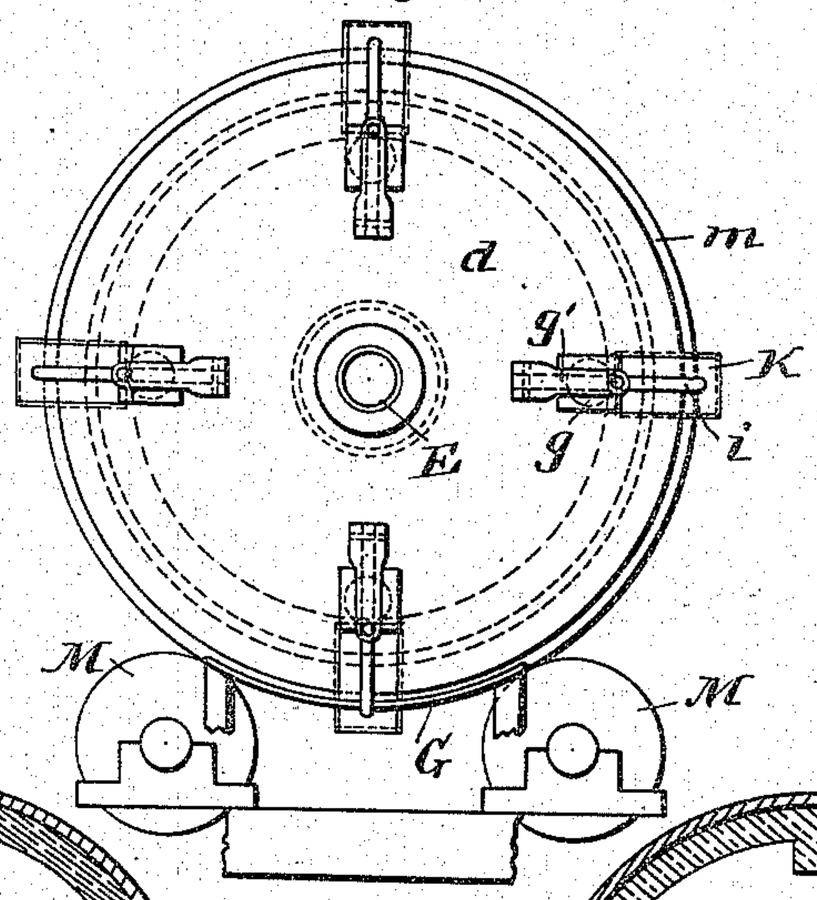


Fig. 3.

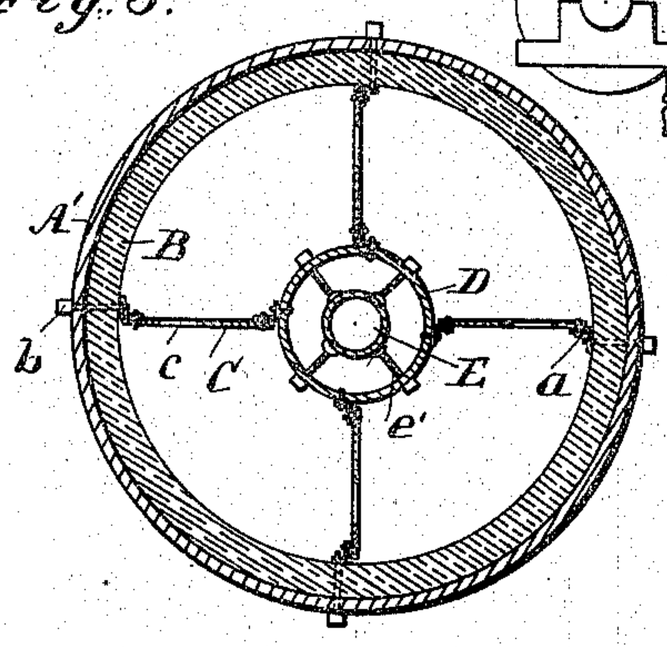


Fig. 4.

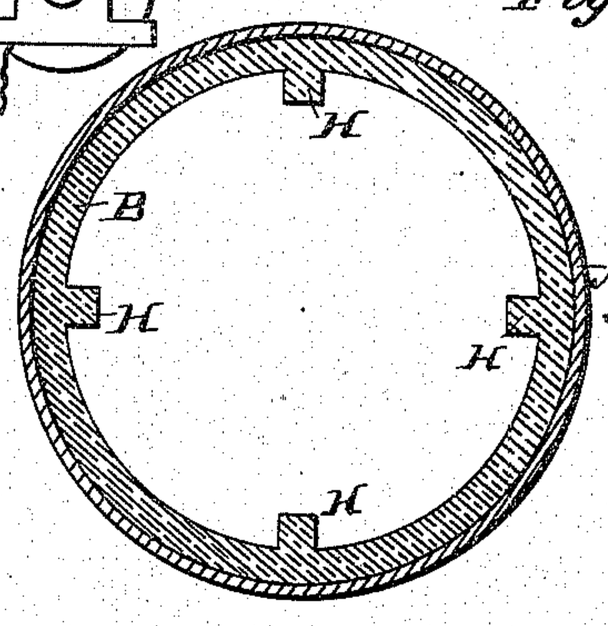


Fig. 5.

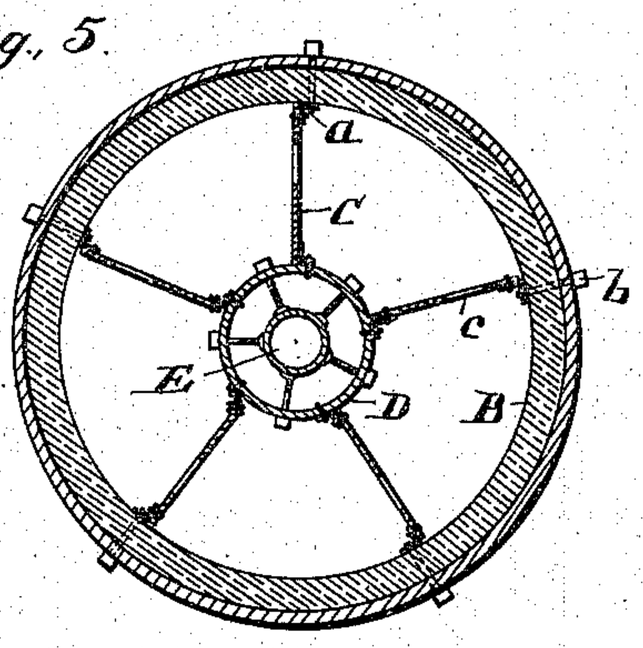
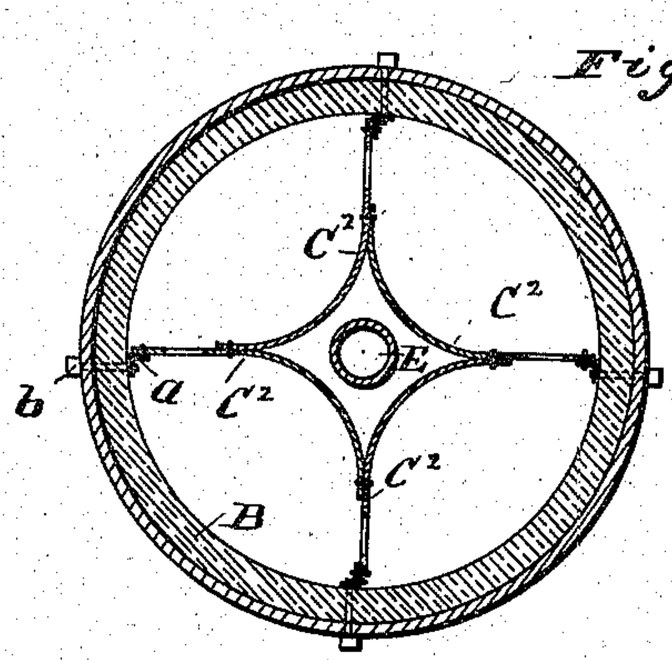


Fig. 6.



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UNITED STATES PATENT OFFICE.

PAUL NAEF, OF ARGENTINE, KANSAS.

FURNACE FOR ROASTING ORES.

SPECIFICATION forming part of Letters Patent No. 528,016, dated October 23, 1894.

Application filed August 25, 1893. Serial No. 484,070. (No model.)

To all whom it may concern:

Be it known that I, PAUL NAEF, a citizen of Switzerland, residing at Argentine, in the county of Wyandotte and State of Kansas, have invented certain new and useful Improvements in Furnaces for Roasting Ores; and I do hereby declare the following to be a full, clear, and exact description of the invention, 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, and to letters of reference marked thereon, which form a part of this specification.

The invention relates particularly to the class of revolving cylindrical roasters in which the pulverized ore or other material to be roasted or calcined is fed into an inclined cylinder at one end and discharged at the other, the ore passing into and out of the roasting cylinder in a continuous stream, and the object of the present invention is to provide such a furnace which will afford a most intimate contact between the pulverulent ore and the air admitted for the combustion of the sulphur carried by the ores, and will produce, as a product, a perfectly roasted ore, and also concentrated sulphurous acid gas, by reason of the manner in which the air requisite for the combustion is admitted to the roasting cylinder.

A further object in view is to reduce the first cost of such a furnace and the cost of repair, by a system of iron partitions, and an arrangement of the air inlet ducts and furnace construction which prevents the destruction of the iron used, from too high a heat, or the action thereon of sulphurie acid generated in the furnace.

These objects I attain by means of the construction and arrangement hereinafter described and claimed.

In the accompanying drawings: Figure 1 is a vertically longitudinal section of a revolving roasting furnace embodying the present invention. Fig. 2 is an end view of the discharge end of the same. Fig. 3 is a transverse section taken on the line *x—x* Fig. 1. Fig. 4 is a transverse section taken on the line *y—y*, Fig. 1; and Figs. 5 and 6 are transverse sections of a roasting cylinder illustrating modifiations in the construction of the partitions.

The roasting cylinder A is constructed of an iron shell A′, lined throughout with fire brick B. It is supported on rollers M, M′, as many as requisite, the cylinders being generally about thirty feet in length, and driven by a worm pinion N, engaging with a rack circle *n* carried by the cylinder, or otherwise. The bearing rings for the rollers M and M′ are shown at *m m′* respectively. The fire brick lining to the furnace is, with advantage, made of considerable thickness so as to retain heat and equalize the roasting. On the inside of the brick lining of the cylinder and extending longitudinally therewith, there are the angle irons *a*, attached to the outer iron shell A′ by bolts *b* which pass through holes in the fire brick lining, B. To these angle irons there are bolted or riveted the radial iron partition plates C, C, which plates, in the first form of construction illustrated, are bolted, or riveted, along their inner edges to angle irons or flanges attatched to or formed on the central iron tube D.

Each of the plates C is provided with a line of holes, *c*, and as the cylinder revolves the partitions successively lift the ore and allow it to fall in a shower through the holes *c*, from one of the radial chambers formed by the partitions into the next chamber. Thus a shower of ore is produced over the whole cross section of the cylinder.

The discharge end of the roasting cylinder is closed by a plate *d*, which plate also closes in the end of the iron tube D, and the opposite end of the tube D is closed by a head plate *d′*. Through the center of the plate *d* there is inserted a smaller pipe E, an air inlet, which pipe extends in nearly to the farther end of the encompassing pipe D, and is supported and stayed to the latter by the bolts *e′*. Openings *e* are provided in the pipe D near the discharge end of the cylinder, for the passage of air from the central pipe into the roasting cylinder as hereinafter described.

In most cases it is not desirable to allow iron constructions to come in contact with the ore during the first stage of roasting, for the heat at that point is the greatest, and further if the moisture is all driven off from the

fresh ore before it reaches the iron parts of the roaster, the destruction of the latter by sulphuric acid is avoided. To this end the iron partitions, C, and the central tube, D, do not extend entirely through to the receiving end of the roasting cylinder, but stop short as shown; and the brick lining of the upper end of the cylinder is provided with longitudinally projecting ledges H which form ore lifters that carry up the ore as the cylinder slowly revolves, and allow it to fall back in showers.

The upper end of the cylinder fits closely against the face of the stationary flue P, which may lead to a chimney stack or to appliances for treating or saving the sulphurous or other gases produced by the roasting process. A feed chute for the ore is shown at R and the ore is fed into the cylinder in a steady stream, by any suitable automatic feeding device in the usual way. In the present case a feed hopper and chute simply are shown, it not being necessary to illustrate the details of an automatic feeder.

The successful operation of the roasting furnace requires the exclusion of all air except such as enters through the air inlet pipe E and becomes warm before it reaches the ore, and also calls for a uniform and automatic discharge of the roasted ore. For this purpose there are discharge openings *f*, in the discharge end *d* of the cylinder, one opening for each longitudinal section or apartment. These openings are normally closed by means of the spring pressed covers or doors *g*, each of which is hinged to a supporting arm *g'*, and has an outwardly extending arm *i*.

h is the spring for holding the door against its seat.

G is a stationary rod or cam surface conforming in curvature to the diameter of the cylinder as will appear from Fig. 2, and so placed with respect to the end of the roasting cylinder that it will engage with the rods *i* and press them back, opening the discharge holes *f* as they successively approach the bottom position, and hold them open for a short period. After each rod *i* has passed the stationary cam rod G, the cover closes down on its opening till the furnace has again made a revolution, and the opening remains closed against the admission of cold air. In connection with each opening, *f*, there is a slide K which can be pushed in more or less in order to reduce the size of the opening *f*. The openings *f* when fully opened extend to the inner edge of the cylinder lining, and by pushing in the slide K, it will be seen that a barrier is formed against the free discharge of all ore resting at that point on the bottom of the cylinder. Only such ore as can flow over the inwardly projected end of the slide plate K can be discharged. Hence the amount of ore in the furnace can thus be regulated at will according to the character of the ore, which is a great advantage in securing good roasting.

It will be seen that it is not material how many of the iron partitions the furnace has. Instead of four as above described there may be six, as illustrated by Fig. 5, and in this case there would be six discharge openings. In Fig. 6 each of the partition plates C^2 is bent laterally and riveted along its inner edge to the adjacent plate, thus inclosing a central space which performs the function of the tube D in the first construction.

The operation of the furnace is briefly as follows: The ore being fed in steadily and continuously through the feed spout R it enters the upper end of the cylinder and as the latter slowly revolves it is carried up by the ledges H, and later by the partitions C, and showered through the openings *c*, thus giving an intimate and oft repeated contact between the ore particles and the hot air. Finally when the ore reaches the lower end of the cylinder it discharges through the openings *f*, the same being automatically opened for a short period of time, as before described, when they reach the lower part of the cylinder's revolution, and then closed for the rest of the circle. The air enters only through the center pipe E and natural draft alone may be used or it may be forced in by means of a fan or blower. Passing in to the farther end of the pipe E it then returns through the annular passage around the pipe E and within the pipe D, or in the case of the construction illustrated by Fig. 6 through the tight central channel around the pipe E. The air then enters the roasting part of the furnace through the holes *e*. During the passage of the air along the red hot iron it is heated, and the iron, especially at the inner end of the flue D where the heat from the roasting of the fresh ore is the greatest, is cooled and preserved from destruction. A part of the superfluous heat, which is produced by the intense combustion of fresh ore near the feeding end of the furnace, is thus transported to the discharging end, where in ordinary furnaces a large volume of cold air meets partially burned ore and reduces the heat below the roasting temperature. If ore is to be roasted which does not furnish enough heat by its own combustion, the air can be heated before it is introduced through the pipe E.

Having thus described the invention, what I claim as new is—

1. A revolving roasting furnace having a central metal air inlet pipe receiving air in at one end and with openings therefrom into the roasting cylinder only at the discharge end thereof, in combination with metal partitions connecting said central pipe with the cylinder walls, said partitions having holes for the passage of ore therethrough, substantially as and for the purpose set forth.

2. In a revolving roasting cylinder the com-

bination with an inner air inlet pipe leading in from the discharging end of the furnace toward the feeding end, of an outer pipe encompassing the same and forming a return passage for the incoming air back to the discharging end, said outer pipe having air passages from the same into the roasting chamber only at the discharging end of the cylinder, substantially as and for the purpose set forth.

3. A revolving roasting cylinder having an open section at the feeding end with lining and ore lifting devices carried thereby of fire brick, in combination with a metal air inlet pipe and ore lifting partitions extending through the lower portion of the cylinder, said air inlet pipe discharging air into the roasting chamber near the discharging end thereof, substantially as and for the purpose set forth.

4. A revolving roasting cylinder having one or more discharge openings in the end wall thereof with spring pressed doors therefor, each hinged to the cylinder between the opening and the cylinder axis and having a radially and outwardly projecting arm therefor, in combination with a stationary piece so placed as to engage with said arms and temporarily open the doors, substantially as and for the purpose set forth.

5. A revolving roasting cylinder having an open section at the feeding end with lining and ore lifting devices of fire brick, in combination with an air inlet flue and metal ore lifting devices extending through the lower portion of the cylinder, said air inlet flue discharging air into the roasting chamber near the discharge end thereof, substantially as and for the purpose set forth.

6. A revolving roasting cylinder having one or more discharge openings in the end thereof, said openings extending inward from the surface of the furnace lining, with movable slides therefor adapted to be moved radially inward, whereby the amount of ore retained in the cylinder can be regulated, substantially as set forth.

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Witnesses:
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S. B. DAVIS.