No. 850,039. PATENTED APR. 9, 1907.

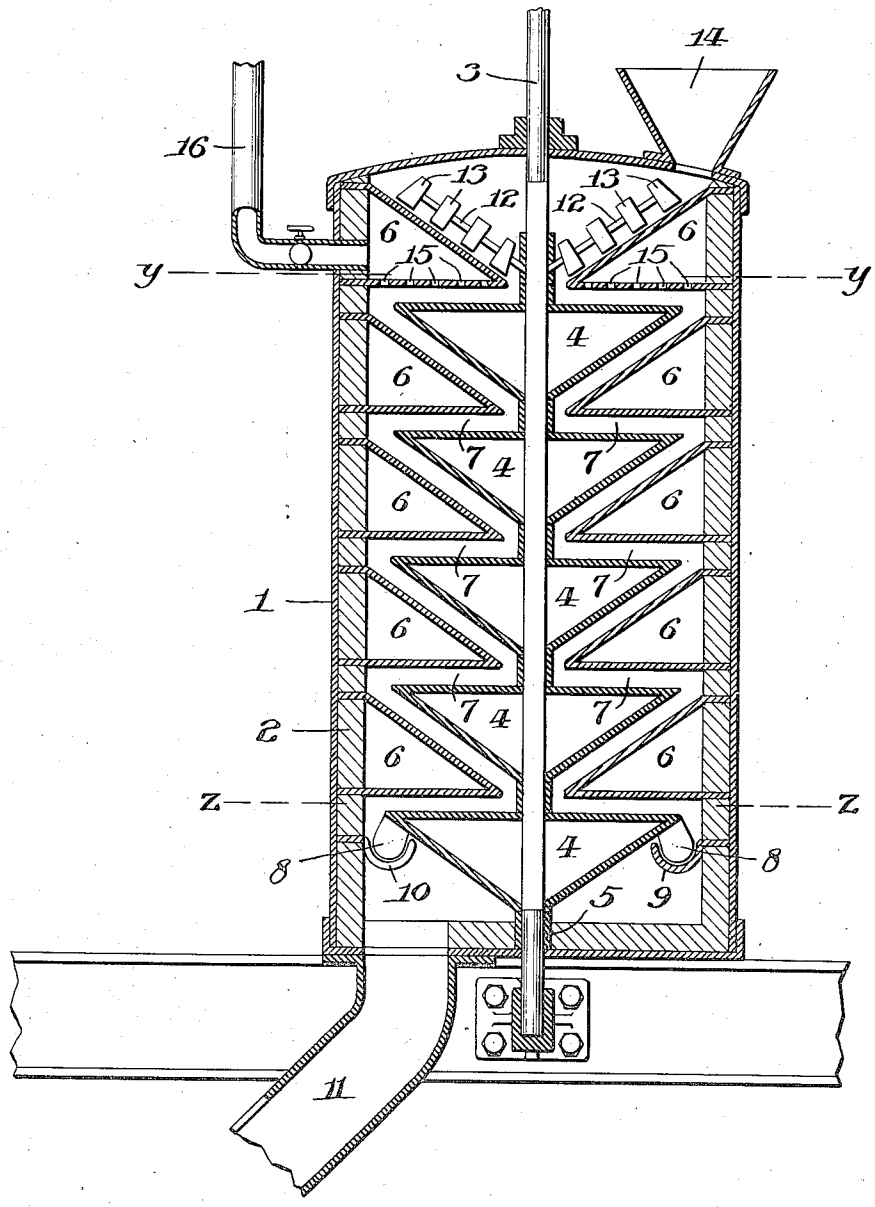
R. McKNIGHT.

ORE ROASTING APPARATUS.

APPLICATION FILED JULY 6, 1903.

2 SHEETS—SHEET 1.

Fig. 1.



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ORE ROASTING APPARATUS.

APPLICATION FILED JULY 6, 1903.

2 SHEETS—SHEET 2.

Fig. 2.

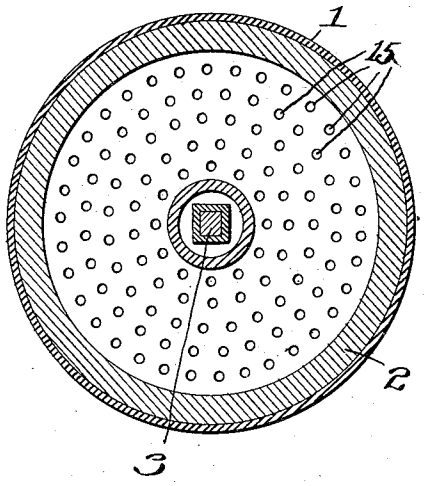
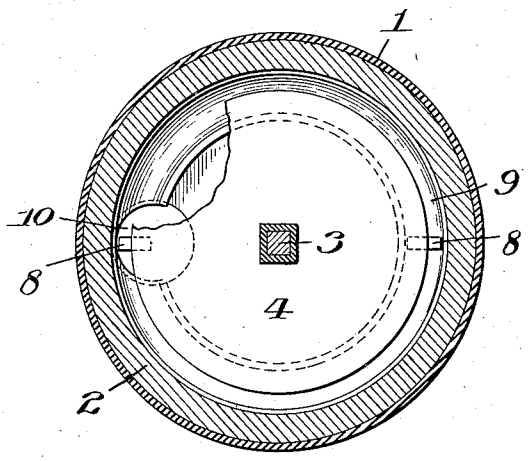


Fig. 3.



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ORE-ROASTING APPARATUS.

No. 850,039. Specification of Letters Patent. Patented April 9, 1907.

Application filed July 6, 1903. Serial No. 164,342.

To all whom it may concern:

Be it known that I, ROBERT McKNIGHT, a citizen of the United States, residing at the city and county of Philadelphia, in the State of Pennsylvania, have invented certain new and useful Improvements in Ore-Roasting Apparatus, of which the following is a full, clear, and exact description, reference being had to the accompanying drawings, of which—

Figure 1 is a vertical section of an ore-roasting apparatus embodying the herein-described invention. Fig. 2 is a full section on line *y y*, Fig. 1. Fig. 3 is a similar section on line *z z*, Fig. 1.

This invention is an improvement in apparatus in the nature of a roasting-furnace for use more especially in carrying on processes for the volatilization of precious metals from their ores and the recovering of the metal values contained in the fumes of volatilization—such, for example, as the process described in Letters Patent of the United States issued October 27, 1901, No. 685,691.

The main object of the invention is to provide such an apparatus in which balling or caking of the ore being treated is obviated or minimized, and also to completely expose the ore to the influence of the air in the furnace.

The invention consists in certain devices and combinations hereinafter described and particularly pointed out.

Referring to the accompanying drawings, one portion of the apparatus consists of a fixed cylindrical structure 1, preferably lined on the inner side with fire-brick 2. Concentric with this structure is a vertical shaft 3, that is journaled in suitable bearings and is adapted to be rotated from a source of power. Fixedly mounted on this shaft is a series of obconic cones 4, of suitable material and preferably hollow, as shown. As a convenient means for securing these cones to the shaft 3, so as to be rotatable therewith, I make said shaft square in cross-section, (except the part within the bearings,) the holes of the cones being provided with corresponding openings to receive the shaft, as seen. The said cones are slid upon the shaft, the lower end or hub of each resting upon the top of the next below, and the lowermost cone resting upon the bottom of the cylinder or, rather, in this instance upon a box or bearing 5 of the shaft, which bearing extends through the fire-brick lining of the bottom of the cylinder.

Secured to and extending from the inner wall of the cylinder are a series of annuli 6, preferably hollow, as shown, whose upper walls are inclined downwardly and their lower walls or bottoms are substantially horizontal. The purpose in inclining downwardly the upper walls of each of the annuli 6 is to discharge the gravitating ore at the center of the next lower cone, and thus hold the ore upon the cones for the greatest period of time. The dimensions of these annuli are, as shown in Fig. 1, such as to leave an annular passage-way 7 communicating between the bottom of each annulus and the top of the next cone below and between the sides of the annulus and the side of the cone. There is no annulus below the lowermost cone, which cone is provided on opposite sides near its periphery with scrapers 8, two in the present instance, that project into an annular trough 9, that is cut away at one point to an opening 10, Fig. 3, that is above an outlet pipe or conduit 11 (hereinafter referred to) in the bottom of cylinder 1.

Mounted obliquely upon the shaft 3, or, for convenience, upon the upper hub of the uppermost one of the cones 1, are two or more arms 12, Fig. 4, to which are secured a numbers of scrapers or stirrers 13, whose lower ends are adjacent to the inclined top of the upper one of the annuli 6.

14 is a hopper at the top of the cylinder 1 from which the ore to be treated is fed into the apparatus.

The bottom of the upper annulus is provided with numerous perforations 15, and extending through the cylinder at a point above said bottom is a pipe 16 for the escape of the fumes.

Having thus described my invention, I proceed to explain the mode of operation thereof, as follows: The furnace having been started and the interior of cylinder 1 becoming heated to a required temperature, the shaft 3 is driven at a suitable speed, thus rotating the cones 4. The pulverized ore or ore mixture is now fed into the hopper 14 and descending upon the inclined top of the upper one of the annuli 6 is scraped or agitated by the rotating scrapers 13 and falls upon the top of the upper one of the cones 4 adjacent to the shaft 3. The rotation of the cone carries the ore outwardly in a thin layer by the centrifugal force to the periphery of the cone, and it (the ore) then falls down the incline of the second annulus 6, upon the sec-

ond cone, near its central portion, and so on successively from cone to cone on to the top of the lowermost cone, from which it falls into a circular trough 9 and is carried by the scrapers 8 to the opening 10, whence it falls into the pipe 11 and is delivered from the cylinder 1. During the entire course of the ore or ore mixture it is agitated and spread out and is at the same time subjected to a roasting process by the heat of the furnace and the air that enters the open end of the cylinder. In case the amount of this air be insufficient means may be employed for forcing a current of air up through the apparatus. The fumes formed in the process rise up through the apertures 15 of the bottom of the upper annulus 6 and pass off by way of the fume-pipe 16 to a suitable condenser. Usually it will be necessary or desirable to use a suction device to aid in drawing off the fumes.

As is well known, in roasting ores containing gold and silver and also containing metalloids—such as sulfur, phosphorus, &c.—a caking or balling usually occurs, thus preventing perfect roasting and necessitating regrinding of the balled ore. Similar difficulty occurs when ores containing antimony, bismuth, &c., are subjected to a temperature of more than about 300° centigrade. Also ordinarily ores containing the precious metals and lead or antimony cannot be thoroughly roasted with sodium chlorid or other haloids without balling. With my apparatus, however, the ore being agitated and thrown outwardly in a succession of thin layers or bodies by the centrifugal force the heat or hot air entering the vertical vessel or cylinder 1 from the pipe 11 can reach every particle of the ore, and certain metal or metalloids that would cause caking or balling are eliminated—that is, the gradual travel or descent of the ore from a low to a high temperature volatilizes the excess of metals and metalloids that cause the difficulty before mentioned.

Instead of having the lower end of cylinder 1 communicate with the furnace, and thus allowing the products of combustion to pass through the apparatus, I may sometimes use a furnace for generating superheated air, which is allowed to enter or forced into said cylinder. I further remark that the fume-pipe 16 may have branches communicating with the interior of the cylinder 1 at different points or heights in a manner similar to that shown in the drawings.

The scrapers 13 may sometimes be dispensed with, as also the scrapers 8, and the trough 9 and other means substituted for conducting the ore to or causing it to escape into the pipe 11.

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

1. In an ore-roasting apparatus, the combination with a hollow cylinder, of a vertically-arranged rotatable shaft therein, a series of obconic cones mounted on said shaft, a corresponding series of annuli extending from the sides of said cylinder and arranged in the spaces between said cones to form a continuous passage-way between the latter and said annuli, said cylinder having at its upper end an inlet for the ore and also at its lower end an exit for the ore, a trough arranged below the edges of the lower cone for receiving the ore from the latter, scrapers carried by said lower cone for discharging the ore from said trough into the exit in the lower end of the cylinder, the topmost annulus being perforated for collecting the fumes rising through the cylinder, and a pipe connected to said topmost annulus for leading the collected fumes therefrom.

2. In an ore-roasting apparatus, the combination with a hollow cylinder, of a vertically-arranged rotatable shaft therein, a series of obconic cones mounted on said shaft, a corresponding series of annuli extending from the sides of said cylinder and arranged in the spaces between said cones to form a continuous passage-way between the latter and said annuli, said cylinder having at its upper end an inlet for the ore and also at its lower end an exit for the ore, a trough arranged below the edges of the lower cone for receiving the ore from the latter, scrapers carried by said lower cone for discharging the ore from said trough into the exit in the lower end of the cylinder, the topmost annulus being perforated for collecting the fumes rising through the cylinder, a pipe connected to said topmost annulus for leading the collected fumes therefrom, and scrapers connected to said shaft and extending adjacent to the upper side of the topmost annulus.

In testimony whereof I have hereunto affixed my signature this 13th day of June, A. D. 1903.

ROBERT McKNIGHT.

Witnesses:
L. M. SIMPSON,
D. H. LANG.