A. S. DWIGHT & R. L. LLOYD.

APPARATUS FOR DESULFURIZING AND SINTERING ORES.

APPLICATION FILED JULY 23, 1907.

916,395. **Patented Mar. 23, 1909.**

Fig. 1.

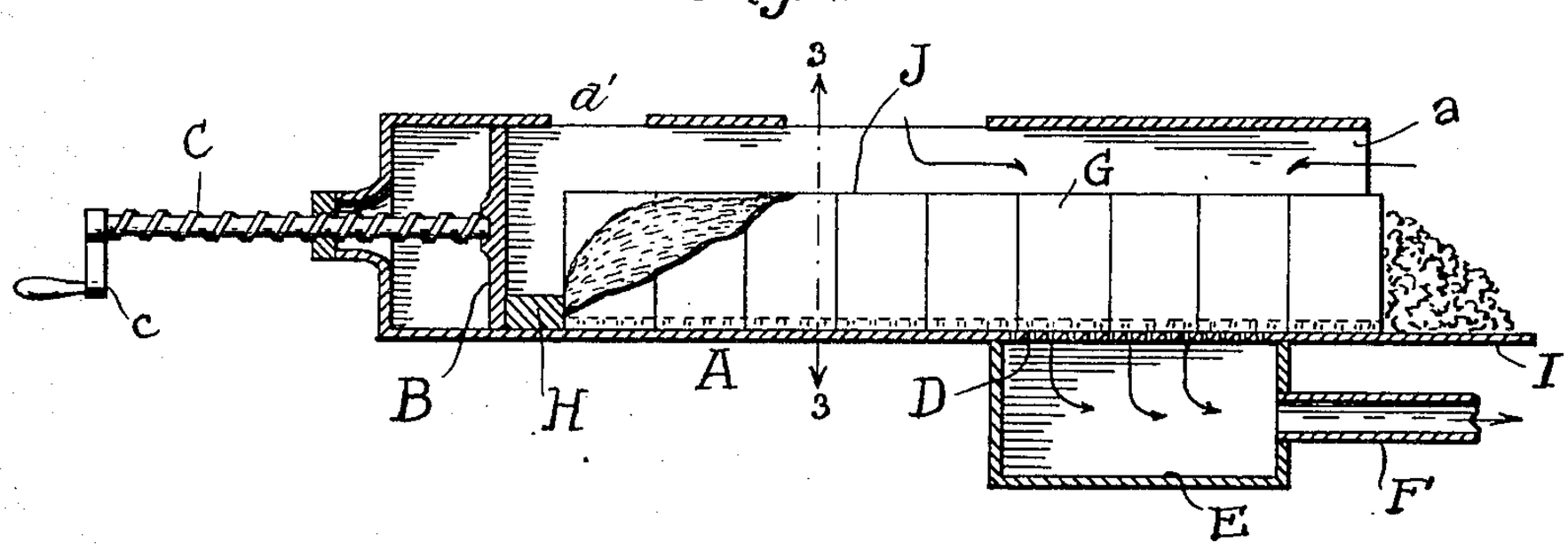


Fig. 2.

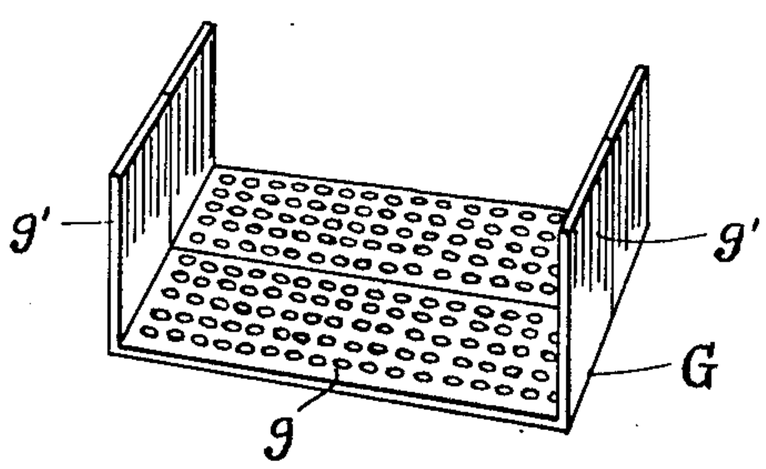


Fig. 3.

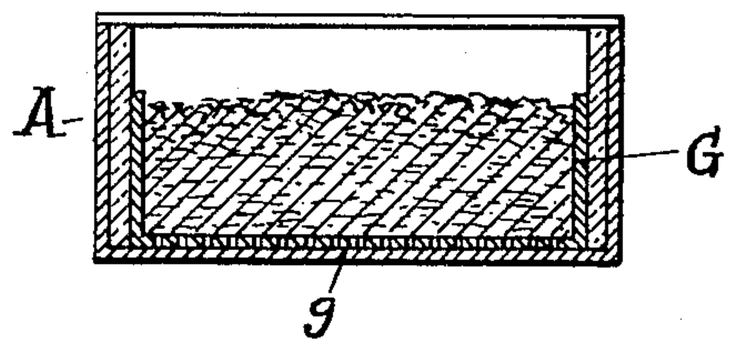
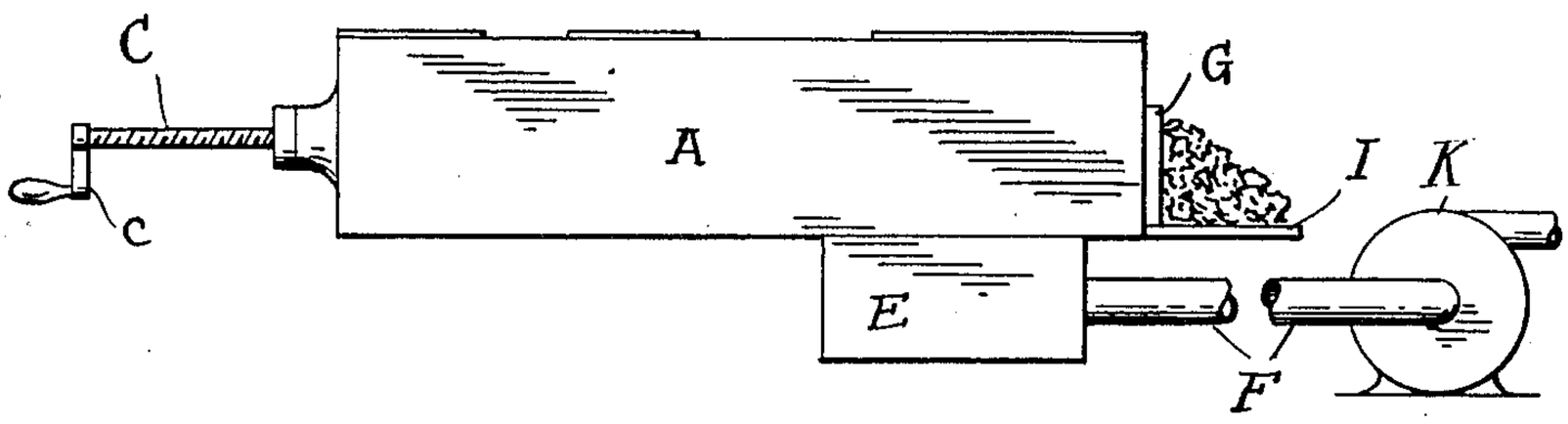


Fig. 4.



Witnesses

Stuart Hilder.
George Edelin

Inventors

Arthur S. Dwight and
Richard L. Lloyd
By H. H. Bliss
Attorneys

UNITED STATES PATENT OFFICE.

ARTHUR S. DWIGHT, OF JOLIET, ILLINOIS, AND RICHARD L. LLOYD, OF CANANEA, MEXICO, ASSIGNORS TO FRED BENNITT, TRUSTEE, OF JOLIET, ILLINOIS

APPARATUS FOR DESULFURIZING AND SINTERING ORES.

No. 916,395. Specification of Letters Patent. Patented March 23, 1909.

Original application filed July 30, 1906, Serial No. 328,387. Divided and this application filed July 23, 1907. Serial No. 385,097.

To all whom it may concern:

Be it known that we, ARTHUR S. DWIGHT and RICHARD L. LLOYD, citizens of the United States, residing, respectively, at Joliet, in the county of Will and State of Illinois, and Cananea, in the State of Sonora and Republic of Mexico, have invented certain new and useful Improvements in Apparatus for Desulfurizing and Sintering Ores, of which the following is a specification, reference being had therein to the accompanying drawing.

Our invention relates to machines or apparatus for treating metal bearing ores and more particularly to apparatus for desulfurizing and sintering ores and concentrates, and its objects are to produce apparatus by which such materials may be cheaply and efficaciously operated upon, and to render possible a continuous treatment of the materials, as distinguished from intermittent operations, the raw ores being fed into one end of the apparatus, the sinter being taken from the other end, and the products driven off being taken away at an intermediate point.

The invention has further for its object to make it possible to recover as by-products materials or substances which have heretofore usually been passed off in a gaseous condition and lost, or recovered only by the use of complicated and expensive processes and apparatus.

The invention contemplates the treatment of the ore during the desulfurizing and sintering processes, with a current of air or other suitable gaseous fluid passing freely through the mass, the direction given to the current being such that the materials or substances driven off by the heat of combustion shall be carried thereby away from the advancing zone of combustion rather than through the intense heat found at that point so that certain by-products can be more easily recovered.

Figure 1 is a longitudinal sectional view of an apparatus embodying our invention. Fig. 2 is a perspective view of two of the sections or pallets employed in the apparatus for supporting and carrying material while being treated. Fig. 3 is a cross-sectional view taken on the line 3—3 of Fig. 1. Fig. 4 is a side view of the apparatus.

In the accompanying drawings, A represents the furnace or inclosing structure. It consists of a longitudinal and preferably horizontally arranged box-like or tubular structure constructed of suitable refractory material. One of its ends *a* is preferably left open, this being the delivery end. At the other end there is arranged a feeding device, preferably a reciprocating feeding device. This feeding device may be of any suitable character. The form we have indicated consists of a plunger B, operated by a screw-shaft C provided at its end with a handle *c*.

At *a'* there is a feed opening through which the raw material can be passed into the furnace. At some point intermediate the feed opening *a'* and the delivery end *a* of the furnace, the bottom of the furnace is provided with a grate or perforated portion D that opens into a suction-box E, with which connects the exhaust pipe F, leading to a fan K.

The material being treated is supported while in the furnace by a carrier that advances it gradually from the feed to the discharge end of the furnace. The carrier is preferably of sectional form or construction such as indicated in Fig. 2, where G represents a pallet having a perforated bottom *g* and side walls *g'*, the top and ends being left open. The sections G are arranged to be placed end to end and to constitute a grate or carrier of indefinite length accordingly as many or few are used. It will be understood by reference to the drawings that the pallets are removed as they reach the end of the furnace and are successively placed in the furnace at the feed end, where they are filled with material to be treated. The bottom of the carrier being perforated permits a free passage of air or other gases or vapors through the material from the upper part of the furnace into the suction-box, the draft being induced by a suitable exhaust mechanism, connected with the pipe F.

H indicates a block that may be interposed between the pusher-head B and the first of the pallets at the head or feed end of the furnace.

I indicates a shelf constituting in effect a continuation of the bottom of the furnace beyond the rear end *a* thereof. Upon this

shelf the sintered mass of material passes, whence it may be removed, the pallets being separated therefrom and returned to the head end of the furnace for repeated use.

The carrier constitutes a sectional or articulated grate or screen, upon which the material being treated is supported while within the furnace.

The method of operating the apparatus may now be described. The apparatus is particularly adapted for the treatment of fine concentrates of such ores as iron, copper, lead and those of the precious metals, particularly when such ores bear sulfur. In our apparatus and according to our process it is possible to treat very finely subdivided ores without serious loss through dust. We ordinarily mix about 15 per cent. of crushed sinter from a previous operation with the concentrates or ores to be treated before charging the furnace, and this we do for several reasons, among which may be mentioned the following: (1) to increase the porosity of the charge, thereby decreasing the power required to blow it; (2) to reduce the proportion of sulfur in the charge, thereby enabling the process to be more rapidly worked, and to prevent the formation of a too easily fusible mass, keeping the material granular and open for the passage of air, vapor or gases until the process has been carried forward far enough for the sintering operation to take place. We do not, however, limit ourselves to this particular mixture for the furnace charge, as we sometimes replace the crushed sinter by calcined concentrates or fine flue dust from the blast furnace. Probably also lime could be mixed with the ore or concentrates and satisfactory results obtained. The material to be treated in the furnace, whatever its particular composition, is charged through the opening *a'* and fills the pallets G, which are under or opposite to the feed opening. As the carrier is filled it is gradually fed forward by the feeding mechanism with which the furnace is provided. The charge is ignited from the top, at about the point J, where there is provided an opening in the furnace for the admission of air or steam or other gas or vapor which may be employed in the blast. The charge may be ignited by placing burning coals upon the top of the mass or by an oil or gas flame. After the charge has been ignited combustion can usually be maintained and the heat necessary to conduct the sintering process may usually be derived from the chemical reactions which take place in the materials themselves. It may, however, be maintained from extraneous sources if found necessary. It will be observed that the combustion begins in the upper portion of the charge and advances downward toward the grate D. This favors the recovery of certain by-products, such as sulfur, either in a molten state or by sublimation, for the heat produced in the zone of combustion tends to liquate or vaporize the sulfur which is carried by gravity, and the air blast, downward away from the zone of most intense heat and toward the grate D, where it may escape. We have by our process and apparatus been able to recover as molten sulfur nearly 5 per cent. of the entire weight of the material under treatment. We have also been able to recover during the desulfurizing and sintering process a certain proportion of metallic lead, as well as other substances valuable as by-products. These substances which are set free in a molten, sublimated or vaporous condition are carried away from the zone of combustion and intense heat and are not subject to oxidation, as in the processes now in vogue, and are therefore many of them easily recovered as unoxidized materials. By the time the material has been advanced beyond the grate D practically all the substances that pass off in a molten or gaseous condition have been separated and the mass has become sintered and in proper condition for further treatment in the blast furnace. This sintered mass being porous is quite rapidly cooled by the atmospheric air which passes through it toward the suction-box E, so that by the time it reaches the shelf I it is in condition to be easily handled. It is here broken up and removed by suitable carriers for further treatment.

It will be understood that the form of carrier which we have illustrated, constituting a perforated sectional grate upon which the material rests while in the furnace, while possessing many practical advantages is but one of a type of carriers. We therefore do not wish to be restricted in the application and use of our invention to the particular form of apparatus which we have chosen for the purpose of illustrating our invention. And, again, we note that while we have herein shown an apparatus having what may be termed a "feed opening" and a "discharge opening", and have used those terms in our description thereof, we do not restrict the invention in this respect. The so-called "feed-opening" and the so-called "discharge opening" can be regarded as places or regions where, first the ore is fed or supplied; and second, where the cakes or masses of sintered ore are withdrawn or discharged; and it is in that sense the said terms of description are used. And so in respect to the term "furnace" which is selected for convenience; it is not intended to restrict the invention to an inclosed or approximately inclosed chamber such as is generally found in structures denominated furnaces. It is to be understood as describing a structure where a mass of ore is temporarily supported in such way as to be suitably related to a supply place or

feed region and a discharge region, the structure being adapted to have the material transported from the first of these places to the second and under such circumstances as to permit the application of drafts of air or gases, in the way and for the purposes above described, during the said period of transportation from one to the other.

The apparatus we have described comprises means for supporting a mass of fine ore material containing combustible ingredients in such condition that the particles of the mass are quiescent in relation to each other while the internal combustion in the ore mass is taking place, thus facilitating and permitting the sintering of the entire mass of ore being treated. It also comprises means for advancing the ore mass as a body, without agitation of the particles thereof, while the internal combustion is going on: and means for causing the air or other gaseous fluid that is employed to maintain such combustion to pass through the mass while it is in bodily motion.

We do not herein claim the method or process of treating ore to desulfurize and sinter it described in this specification as we have made such method or process the subject of our application No. 328,387, filed July 30, 1906, of which this case is a division.

What we claim is—

1. A furnace or apparatus for roasting and sintering ore by internal combustion within a mass thereof, having a feed opening at one end, a discharge opening at the other end means between them for transporting a body of ore in a quiescent mass, an opening through which air or gas is supplied at a point intermediate the said ends of the furnace, and a means for taking the products of combustion through the ore mass and arranged on the side of the furnace opposite the draft opening, substantially as set forth.

2. The combination with a furnace or apparatus for sintering ore by internal combustion, having a feed opening and a discharge opening, of a perforated screen or grate upon which the material is supported, means for moving the said screen or grate and the material supported thereon through the furnace, and means for causing the passage of the products of combustion and a current of air or gases through the material and through the said perforated screen or grate, substantially as set forth.

3. The combination with a furnace or apparatus for sintering ore by internal combustion within a mass thereof, having a feed opening and a discharge opening, of a perforated screen or grate upon which the material is supported while in the furnace, means for moving the screen or grate through the furnace, and means for causing a draft to be passed through the material being treated and thereafter through said screen or grate, substantially as set forth.

4. The combination of a furnace or apparatus for sintering ore by internal combustion, and having a feed opening, a discharge opening, and having also a portion of its bottom perforated, a conduit for collecting and carrying away the materials driven off from the ore during its treatment in the furnace, means for advancing the mass of ore through the furnace and across the said perforated bottom thereof, and means for causing the products of combustion to pass through the ore mass and causing currents of air or gas to pass through the ore mass from above, substantially as set forth.

5. The combination of means for supporting a mass of fine ore material containing combustible constituents with the particles of the mass quiescent in relation to each other, means for advancing the said ore mass as a body without agitation of the particles, and means for causing currents of combustion-maintaining gaseous fluid to pass through the mass while in bodily motion for supporting internal combustion therein and causing the products of combustion to pass through the ore mass, substantially as set forth.

6. An apparatus for sintering ore in a fine condition, having at one place a feed region, and at another place a discharge region, means for supporting a mass of ore at points between the said feed region and discharge region, the ore having restraining devices to hold its particles quiescent which lie at the surface where gases escape, means for moving the ore-supporting means from the feed region toward the discharge region, and means for causing currents of air to pass through the ore mass toward the said restraining devices at the surface where the gases escape, substantially as set forth.

7. In an apparatus for sintering fine ore containing combustible constituents, by internal combustion within a mass thereof, having a region where the ore is fed and at another place a region where the sintered ore is discharged, a movable ore-holder adapted to receive a mass of ore to be treated at the place of feed and to hold it while internal combustion is taking place therein so that a sintered cake or mass of the ore will be formed, and having a pervious bottom to allow free circulation through the ore mass to permit internal combustion therein, and means for directing the movements of the ore-holder from the place of feed to that of discharge.

8. In an apparatus for sintering fine ore containing combustible constituents, by internal combustion within a mass thereof, having a region where the ore is fed, a region where sintering and roasting takes

place, and a region where the ore is discharged after being sintered, a series of movable ore-holders adapted to successively pass from the feed region through the roasting and sintering region and to the discharge region of the apparatus, each holder being adapted to receive a mass of ore and hold it until it is formed into a sintered cake or mass, and each holder having a pervious bottom to allow free circulation through the ore mass supported thereby to permit internal combustion therein, and means for directing the movements of the ore-holders, as set forth.

9. In an apparatus for sintering fine ore by internal combustion within a mass thereof, having a region where the ore is fed, a region where sintering and roasting takes place, and a region where the ore is discharged after being sintered, a series of movable ore-holders adapted to successively pass the feed region through the roasting and sintering region and to the discharge region of the apparatus, and each holder being adapted to receive a relatively thin or shallow mass of ore and hold it until it is formed into a sintered cake or mass, and each being open on one side and having retaining side walls and a pervious bottom to allow free circulation through the ore supported thereby while passing through the said region of roasting and sintering to cause internal combustion therein, and means for directing the movements of the ore-holders, as set forth.

In testimony whereof we affix our signatures, in presence of two witnesses.

ARTHUR S. DWIGHT.
RICHARD L. LLOYD.

Witnesses:
EMMA AGUSTA SCHLEICHER,
GRACE ELIZABETH SEYMOUR.