A. S. DWIGHT.

APPARATUS FOR ROASTING AND SINTERING ORES.

APPLICATION FILED APR. 17, 1907. RENEWED JAN. 21, 1910.

1,021,509. Patented Mar. 26, 1912.

Fig. 1

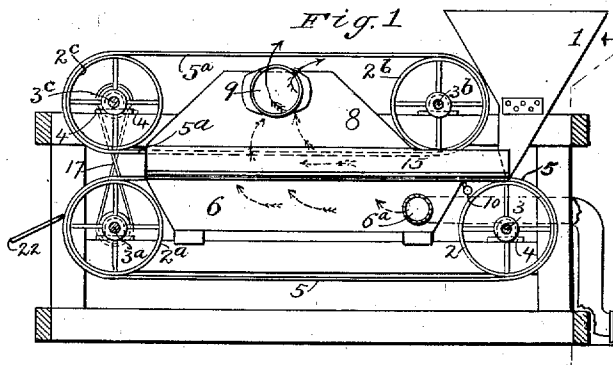


Fig. 2.

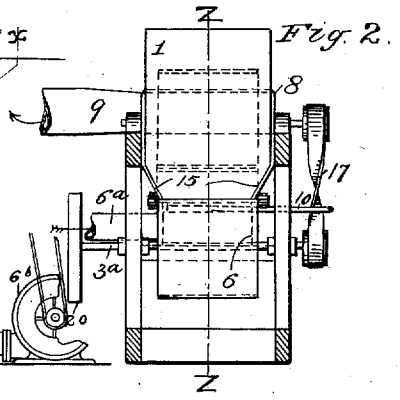
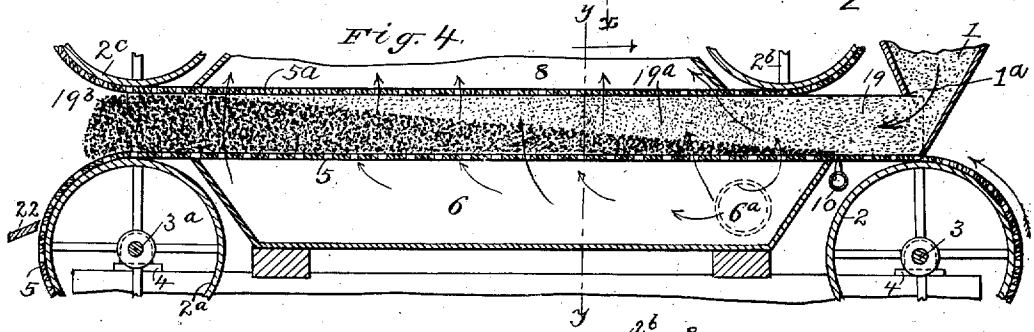


Fig. 4.



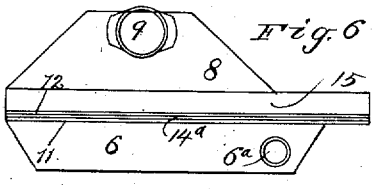
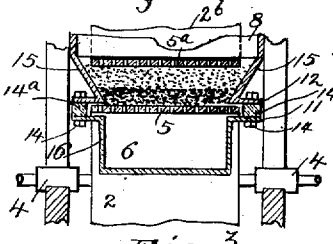


Fig. 6

Fig. 3.



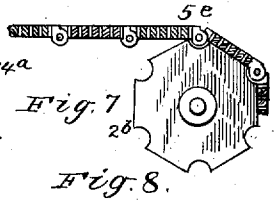


Fig. 7

Fig. 8.

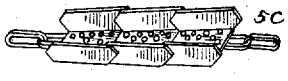
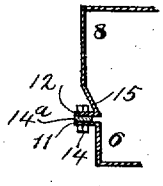


Fig. 5.



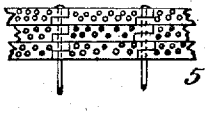
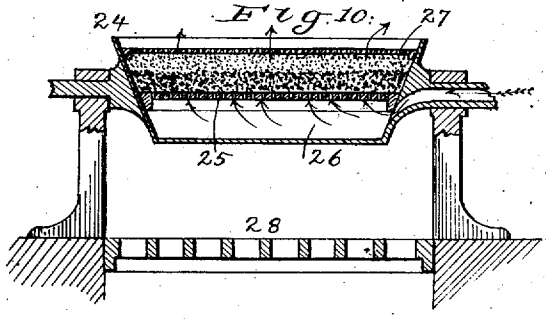


Fig. 9.

Fig. 10.



Witnesses

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UNITED STATES PATENT OFFICE.

ARTHUR S. DWIGHT, OF NEW YORK, N. Y., ASSIGNOR, BY MESNE ASSIGNMENTS, TO DWIGHT AND LLOYD METALLURGICAL COMPANY, OF JERSEY CITY, NEW JERSEY, A CORPORATION OF NEW JERSEY.

APPARATUS FOR ROASTING AND SINTERING ORES.

1,021,509. Specification of Letters Patent. **Patented Mar. 26, 1912.**

Application filed April 17, 1907, Serial No. 368,675. Renewed January 21, 1910. Serial No. 539,314.

To all whom it may concern:

Be it known that I, ARTHUR S. DWIGHT, a citizen of the United States, formerly residing at Joliet, in the county of Will and State of Illinois, and now residing at New York, in the county and State of New York, have invented certain new and useful Improvements in Apparatus for Roasting and Sintering Ores, of which the following is a specification, reference being had therein to the accompanying drawing.

This invention relates to improvements in apparatus for treating metal bearing materials, particularly ores of the metal sulfid class, the apparatus being well adapted for carrying out the process which is presented in the Patents 882,517 and 882,518 issued on the 17th day of March, 1908, to myself jointly with Richard L. Lloyd. In the said patents we illustrated and described a number of devices for supporting and for transporting masses of ore to be treated and for conducting the treatment in such way that a desulfurizing and sintering of the ore could be attained more thoroughly and completely than had been attained by any apparatus or process theretofore known by us. While we therein described, as coming within the general scope of our invention, the supporting or holding of the ore in such way that the particles of the ore mass in advance of the region of combustion were held in quiescence during the desulfurizing and sintering stages, we illustrated more specifically a method and apparatus by which the air or combustion supporting gas was carried downward from the top surface of the mass to the lowermost surface. Under some circumstances it has been found advantageous to support the ore in such way that the draft of air or gas is directed upward or in a direction other than directly downward. And in such case it is necessary to maintain the particles of the ore in a state of quiescence in relation to each other for the same purposes that are fully set forth in the said applications.

I herein present an apparatus by which my present process of treatment can be carried out when the gases are caused to pass in directions other than directly downward.

In the drawings: Figure 1 is a side view of a mechanism embodying my present improvements. Fig. 2 is a cross section on the line x, x of Fig. 1. Fig. 3 is a cross section on the line y, y of Fig. 4, but on a smaller scale. Fig. 4 is a partial longitudinal section on the line z, z of Fig. 2 but on a larger scale. Fig. 5 is a vertical section of one side of the chamber or box for directing the air. Fig. 6 is a side view of the parts in Fig. 5. Figs. 7, 8 and 9 respectively show modified forms of ore supporting and carrying devices. Fig. 10 is a section of a non-traveling and tilting ore support or holder.

In Figs. 1 to 4 of the drawings I have shown an apparatus embodying my improvements, but which, it is to be understood, is typical in character and in respect to which I may make numerous modifications without departing from the essential features of the invention. The operative parts are shown as supported upon a framework having bottom sills, top sills, connecting uprights, cross girts, and intermediate bars or sills, as may be preferred. Upon the framework there is a hopper at 1, preferably of substantially the conformation and relative position shown.

3 and 3^a indicate shafts which are mounted in bearings 4 upon the horizontal elements of the framework. Upon these shafts there are wheels 2, 2^a, which may be of any suitable style, either smooth-faced pulleys, drums or sprocket wheels. Those selected for illustration are of the nature of drums. Upon these there is mounted an endless carrier 5, conventionally illustrated, and made in any way preferred. The body part of the carrier should be pervious to air in order that the passage of air or other gases can be readily permitted. In Fig. 7 it is shown as made of perforated plates 5^e hinged together and mounted upon suitable wheels or drums 2^d. In Fig. 8 it is shown made of pans or pallets 5^b, with perforated bottoms, hinged or linked together or connected to endless chains 5^c. In Fig. 9 a carrier formed of perforated link bars or plates is shown, at 5^d. The carrier 5, although permitting the passage of air or gas therethrough, should be of such nature as to provide support for the mass or layer of ore which is to be subjected to treatment. The ore is indicated in Fig. 4 by 19, 19^a, 19^b. That part indicated by 19 is still in the

crude condition in which it is when stored in the hopper and for a short time after its delivery to the carrier.

19ª indicates the ore while traveling across the region of treatment. At 19ᵇ the finished and sintered product which remains upon the carrier is illustrated. In the present case the ore is supplied with currents of air which, as shown in Figs. 1 to 4, travel upward through the ore mass as it is being carried through the machine.

6 is an air box or chamber situated immediately below the upper run of the conveyer 5, the lower run returning on lines below the box. Air is supplied to this box 6 under pressure from the fan 6ᵇ or other suitable air supplying mechanism through duct 6ª. The dimensions of the air delivery box 6 may be any that are desired, but by preference I form it of about the width of the conveyer and of a length such that it can be readily arranged between the wheels or drums at 2, 2ª.

At 10 I arrange devices by which the combustible elements of the ore mass can be readily ignited. As shown, this igniter consists of a gas pipe arranged transversely of the bed of ore and below the feed hopper and preferably immediately below the perforated or pervious carrier 5. It has a number of gas jets or orifices across the conveyer. The under surface of the ore mass is ignited by this and immediately thereafter reaches the region where the air is forced up through the mass.

For the several reasons set forth in the said earlier applications it is desirable to hold all the particles of the ore mass or layer in such way that they will not be agitated, disturbed or moved in relation to each other during the desulfurizing and sintering stages. When the currents of combustion supporting air or gas are introduced at the bottom of a mass of such ore upward rising air currents tend to destroy the desired quiescence among the particles of ore and to carry off with the moving air currents more or less flue-dust, although their action on the lowermost particles is to some extent overcome by the gravity of those above. As the air rises its force becomes relatively greater and greater and the restraining or holding action of the upper particles becomes less and less efficient. That is to say, the agitation, disturbance and moving of the particles among each other tend to become greater as the air approaches the top. And it is now known that the sintering or agglomerating action among the particles becomes less in substantially the same ratio. Consequently, a large percentage of the ore body in its upper region remains pulverulent, or in the condition of fines, in which they were first introduced. I overcome this tendency to agitate or disturb these particles of the mass which are opposite to the surface where the air enters by providing a covering or blanket for the top of the ore bed which protects the ore from the action of the blast of air, minimizing the amount of flue-dust which might be created by the forced draft passing through the ore. This protecting covering is preferably of such character and so applied that it holds the ore particles in a state of quiescence and at the same time allows the passage of air or the gases of reaction that are produced in the interior of the mass. A perforated or equivalent plate, situated above the ore mass, may be used, or a series of such plates, either resting directly upon the top of the ore mass or supported in such position as to be immediately adjacent to the upper surface thereof. Or use may be made of a device substantially similar to that at 5, above described, for supporting and carrying the ore. These are examples of mechanical, applied, supplemental blankets or protecting and restricting devices. Other forms of retainers or protecting means for the ore may, however, be employed, as for instance a layer of rock or ore of larger particles than the fines constituting the ore mass to be treated, as illustrated in my Patent No. 916,397 dated March 23, 1909.

In Figs. 1 to 4, I illustrate a second endless carrier or belt formed of suitable material, as shown at 5ª, this being supported upon drums 2ᵇ, 2ᶜ, carried by shafts 3ᵇ, 3ᶜ, mounted in bearings at 4. By preference, the drums 2ᵇ, 2ᶜ are so placed that the lower run or tangent portion of this belt 5ª shall be of a length approximately equal to or somewhat longer than the length of the air box 6, it being shown as extending on the delivery side a short distance beyond the box.

The upper and the lower endless elements of the mechanism should be so speeded that they will travel substantially together in order to prevent such disturbance of the ore mass or layer between them as would result in case of difference in speed.

20 indicates the power receiving and transmitting pulley secured to the shaft 3ª.

17 is a belt (here shown as crossed) for transmitting power from the shafting of the lower apron to one of the shafts of the upper apron.

Immediately above the air delivery or inlet box 6 there is a chamber at 8 for collecting and receiving the products of combustion or reaction formed in the ore mass. With this chamber communicates an outlet trunk or duct 9 through which the said gaseous products are withdrawn. So far as concerns the details of construction of the air delivery or inlet box and the collecting box or hood 8 there can be wide election and modification. As shown, these parts are

formed of sheet iron. The side walls of the inlet box 6 have outwardly turned flanges 11 at its upward edge and the upper part of this box or hood has similarly outwardly turned flanges 12 between which there are spacing devices, preferably pieces of asbestos 14ª, and the opposing flanges are rigidly fastened together by the bolts at 14. There are open channels or guideways thus provided in which are fitted the side edges of the conveyer or belt 5, which is thereby held firmly in horizontal position and prevented from unduly sagging. The lower sections 15 of the side walls of the upper part of the box constitute side guides for the ore mass or layer. They are turned inward toward their lower edges so as to tend to hold the material well in at the sides and at the same time make provision for the settling of the ore and for the contraction thereof during the desulfurizing and sintering. The side walls of the upper part of the box at 8 are connected by plates or closures at the ends and top so that the collecting box shall be a comparatively tight and closed chamber.

With parts constructed and arranged as above described the mode of operation will be readily understood. The hopper at 1 is provided with a quantity of the ore to be treated, and which may be understood to be fines of a sulfid ore typified by galena or copper or iron pyrites, separate from each other or mixed. The ore gradually moves downward by gravity and is deposited in a layer on the traveling carrier. It will be seen that the mouth or escape orifice at the bottom of the hopper is of such vertical dimension as to insure that a comparatively deep layer shall be delivered to the conveyer, and one which is uniform in depth, the lower front edge 1ª of the hopper mouth serving as a scraping and leveling device. A relatively slow movement is imparted to the conveyer (in some cases only two inches per minute, depending, however, upon the several factors, such as the length of the conveyer, the thickness of the layer, &c.) but the layer or stream of material soon reaches the vertical plane of the igniting devices at 10 and shortly thereafter the vertical planes of the lower part of the upper belt 5ª, which thereafter rests gently upon the top surface of the ore or lies in close proximity thereto. At about the same time the ore reaches the vertical planes of the air box 6, and air begins to travel with more or less force through the lower surface of the mass and through the interior thereof to the upper surface. At the initial end of the box this air acts first to support and continue the combustion which has been started by the igniting devices. As the stream or layer gradually advances the points of combustion are higher and higher in the body of the ore, finally reaching the upper surface. The heat generated by this internal combustion is such that the sintering or agglomerating of the particles is almost simultaneous with the chemical reaction of the combustion, or, at least, follows quickly thereafter. And as the particles from top to bottom through this portion at 19ª of the ore stream are held against disturbance and maintained in proper proximity one with its neighbors, the sintering action is uniform from bottom to top. This is in contradistinction from the actions which occur when an ore mass of this character is subjected to internal combustion and up-drafts of air without restraining devices or means for holding in quiescence those particles which are in the stratum along the surface where the gases have exit. The various gaseous products of this combustion or chemical reaction are under the action of the draft carried upward into the collecting box at 8 and thence through the duct or trunk 9 to a suitable conduit or stack. It will be understood, of course, that if desired an exhaust device or suction producer can be employed in connection with the collecting box 8 and trunk 9; and, further, that if circumstances permit it such exhaust or suction can be depended upon entirely and pressure devices on the opposite side of the mass can be omitted. The two air boxes 6 and 8 together constitute a blast chamber through which the endless traveling ore carrier, the bed of ore thereon, and the protecting covering or blanket for the upper surface of the ore travel. The parts of the apparatus and the speeds are so related that by the time the layer reaches the end of the air box the combustion will have traveled to the upper surface and the sintering of the entire mass from bottom to top will be completed. This sintered mass advances with the belts for a short distance and is then removed or allowed to drop at points beyond the drums 2ª and 2ᶜ. If required a scraper can be employed at 22 to insure that the sinter shall be effectually detached from the carriers.

Above I have described an apparatus by which the material can be advanced continuously while undergoing treatment. But that the desulfurizing and sintering of the mass, by themselves considered, can be carried on with devices which are stationary will be understood upon examining Fig. 10. In this case a tilting receptacle or ore holder 24 is provided. There are two ore retaining or restraining devices, one below and one above the mass, as shown at 25 and 27. That at 25 may be regarded as a grate or perforated plate. That at 27 may be similar in character and arranged either to rest upon the top of the ore or to have the latter placed with proper compactness or looseness

between the upper and the lower plates. The air is introduced through one of these plates and the products of combustion or chemical reaction escape through the other. If they pass in an upward direction, as is preferable in this case, the upper part at 27 holds the particles in the upper part of the mass in fixed position to insure their sintering. This non-traveling holder 24 may be mounted as shown so as to be tilted or inverted when the sinter is to be emptied out. Below the ore holder there is shown a grizzly or set of grate bars at 28, upon which the sintered cake can be deposited, and which after the cake is broken will permit the lumps of proper size to fall through to a chamber or receptacle which can be provided with a car or conveyer to take off the material.

Inasmuch as the novel method of treatment, or process herein described, does not depend essentially upon the devices herein shown or upon any particular form of apparatus I have in another application filed of even date herewith presented claims for the novel features of such method or process which application has matured into Patent 916,396, dated March 23, 1909.

I do not in this case present specific claims to the form of apparatus illustrated in Fig. 10, as that constitutes the subject matter of an application filed by me on the 2nd day of February, 1910, as a division of this case, bearing Serial Number 541,506.

What I claim is:

1. In an apparatus for treating ores and metal bearing materials, the combination of a support for the material having gas passages, means for igniting the material while on the support on the lower side of the mass, and a substantially horizontally arranged retaining device for the upper part of the material having gas exit passages, substantially as set forth.

2. In an apparatus for treating ores or metal bearing materials, an ore holder having approximately vertical walls or supports between which a mass or layer of the ore can be arranged, and having for the upper and lower surfaces of said mass substantially horizontally arranged retaining devices adapted to prevent the displacement or agitation of the material and provided with gas inlet and gas exit passages, and means arranged below the lower retaining device for igniting the ore, substantially as set forth.

3. In an apparatus for treating metal bearing materials, the combination of a traveling support for the material, means for delivering air to the lower part of the said material whereby combustion can be started and supported in said lower part, and means for holding or restraining in quiescence the particles in the upper part of the mass of material when it is moving bodily, substantially as set forth.

4. In an apparatus for treating ores or metal bearing materials, the combination of a traveling support for the ore, means for delivering air to that part of the same which is adjacent to the support, said support having a section for the reception of crude ore, a section for the support and delivery of sinter, and a section intermediate of the two sections aforesaid whereon the ore can be treated, and means opposite to the last said section for restraining the opposite part of the ore against agitation or disturbance, substantially as set forth.

5. In an apparatus for treating ores or metal bearing materials, the combination of an endless support for a layer or stream of ore adapted to deliver air or gas to the interior of the body of said layer, and an endless restraining device adapted to contact with the mass of ore in opposition to the supporting device, said restraining device being movable in the direction of the support, substantially as set forth.

6. In an apparatus for treating ores or metal bearing materials, the combination of a traveling support for the material adapted to permit the igniting thereof on the lower side of a mass of material and adapted to permit air or combustion supporting gas to enter the lower part of the mass and to travel therethrough, and means for holding or restraining in quiescence the particles in the upper part of the mass of material while it is moving, substantially as set forth.

7. In an apparatus for treating ores and metal bearing materials, the combination of a traveling support for the material adapted to permit the igniting thereof on the lower side of the mass and adapted to permit air or combustion supporting gas to enter the lower part of the mass and to travel therethrough, means above the material for collecting or withdrawing the air or gases of combustion or reaction which escape from the upper part of the mass, and means for restraining against agitation or movement the particles in the upper part of the mass while it is being treated, substantially as set forth.

8. In an apparatus for treating ores and metal bearing materials, the combination of a traveling support for the material adapted to permit the igniting thereof on the lower side and having air passages for the upward passage of air or combustion supporting gas, and means for restraining the particles in the upper part of the mass from disturbance or movement, said means having passages for the escape of air or gases from the mass, substantially as set forth.

9. In an apparatus for treating ores and metal bearing materials, the combination of a traveling support for the material adapted

to support a layer or mass thereof and provided with gas passages, a retaining or restraining device for the upper part of the ore having gas passages, and means for causing the travel of the support and of the retaining or restraining device with approximately equal speeds, substantially as set forth.

10. In an apparatus for treating metal bearing material, the combination of the traveling support adapted to carry a layer or mass of the material, said material being held, substantially as set forth, whereby the lower part thereof can be ignited, means for guiding and delivering air to the said lower part of the mass of material, and a traveling holder or restraining device adapted to engage with the particles of material along the upper surface and hold them in quiescence.

11. In an apparatus for treating ores or metal bearing materials, the combination of the framework and the two opposing traveling ore-supporting and retaining devices adapted to support a layer or stream of ore between them, and having gas passages whereby air or gas can be admitted to one surface of the said layer and gas can escape from the other surface of the layer, substantially as set forth.

12. In an apparatus for treating ores or metal bearing materials, the combination of the framework and the two opposing moving ore-supporting and retaining devices, each provided with gas passages, and means for moving them with substantially equal speeds, substantially as set forth.

13. In an apparatus for preparing ores for blast furnaces, a blast chamber, a traveling carrier operating therethrough, means for delivering the ore to be prepared to such carrier and means for protecting the bed of ores to be prepared from the action of the blast in the chamber.

14. In an apparatus for preparing ores for smelting furnaces and other purposes, a blast chamber, means for continuously feeding the ores to be prepared through such chamber, and means for protecting the bed of ores to be prepared from the action of the blast in such chamber.

15. In a machine for preparing ores and the like for smelting furnaces or other purposes, a blast chamber, a traveling carrier operating therethrough, an ore hopper delivering to said carrier, and igniting means located below the hopper for igniting a portion of the ore adjacent the point of delivery thereof to said carrier.

16. In an apparatus for preparing ores or the like for smelting or other purposes, a blast chamber, a carrier operating therethrough, means for delivering a bed of ore to be treated to said carrier, means for igniting the lower portion of said bed, and means for applying a protecting blanket upon the top of said bed.

17. In an apparatus for preparing ores or the like for smelting or other purposes, a blast chamber, an endless carrier operating therethrough, means for actuating said carrier, supporting means for said carrier, means for continuously delivering a bed of ores to be treated to said carrier, and means for protecting the bed of ores from the action of the blast in the blast chamber.

18. In an apparatus for preparing ores or the like for smelting or other purposes, a blast chamber, a traveling carrier operating therethrough, means for delivering the bed of ore to be treated upon said carrier, means for igniting such material, means for maintaining a blast upwardly through said bed of material and means for protecting the ores from the action of the blast.

In testimony whereof I affix my signature, in presence of two witnesses.

ARTHUR S. DWIGHT.

Witnesses:

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H. E. BUERKLIN.