A. S. DWIGHT.

PROCESS OF ROASTING AND SINTERING ORE.

APPLICATION FILED APR. 17, 1907. RENEWED FEB. 23, 1909.

916,396. Patented Mar. 23, 1909.

Fig. 1.

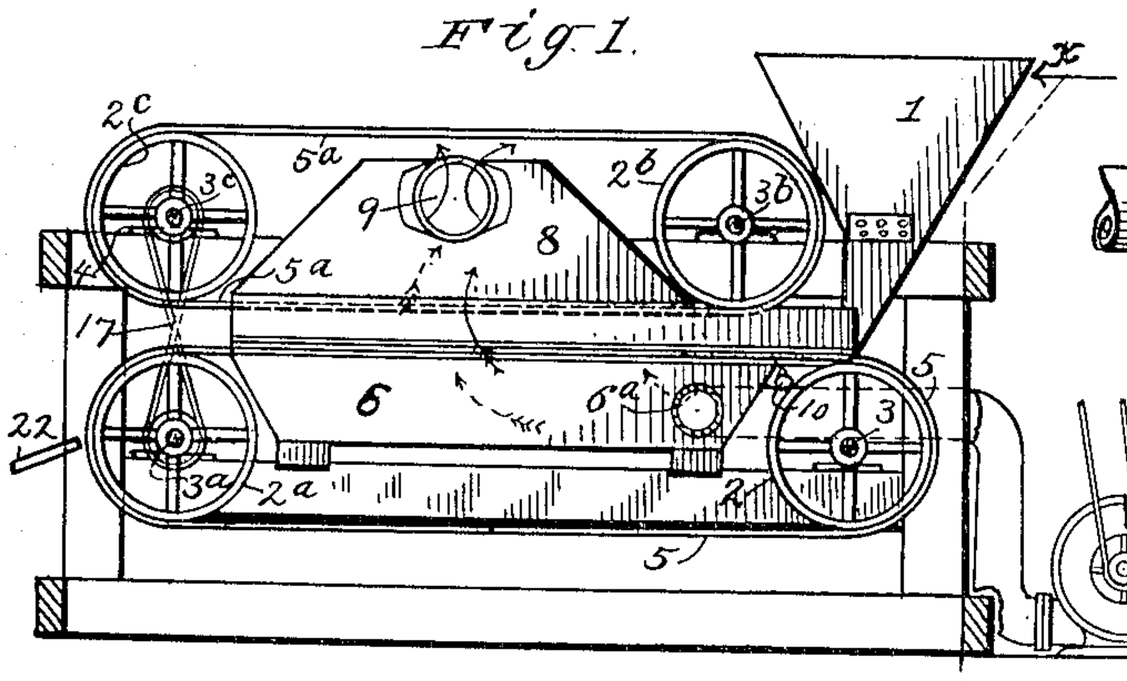


Fig. 2

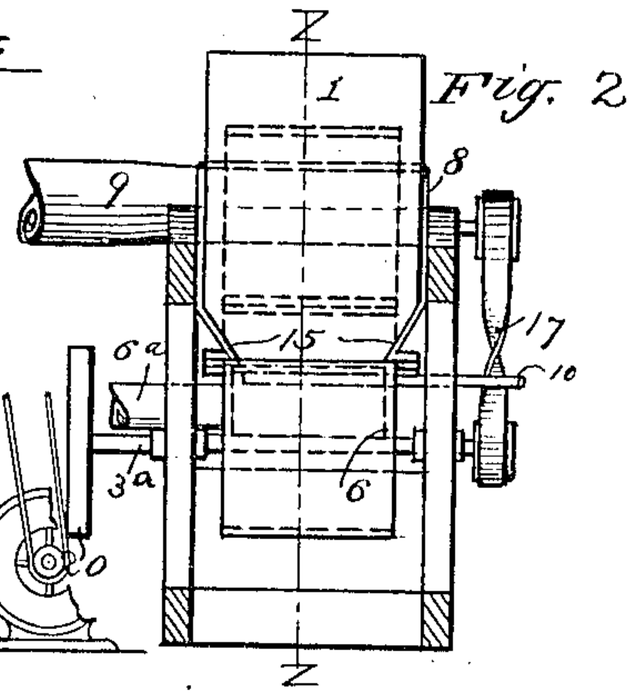


Fig. 4

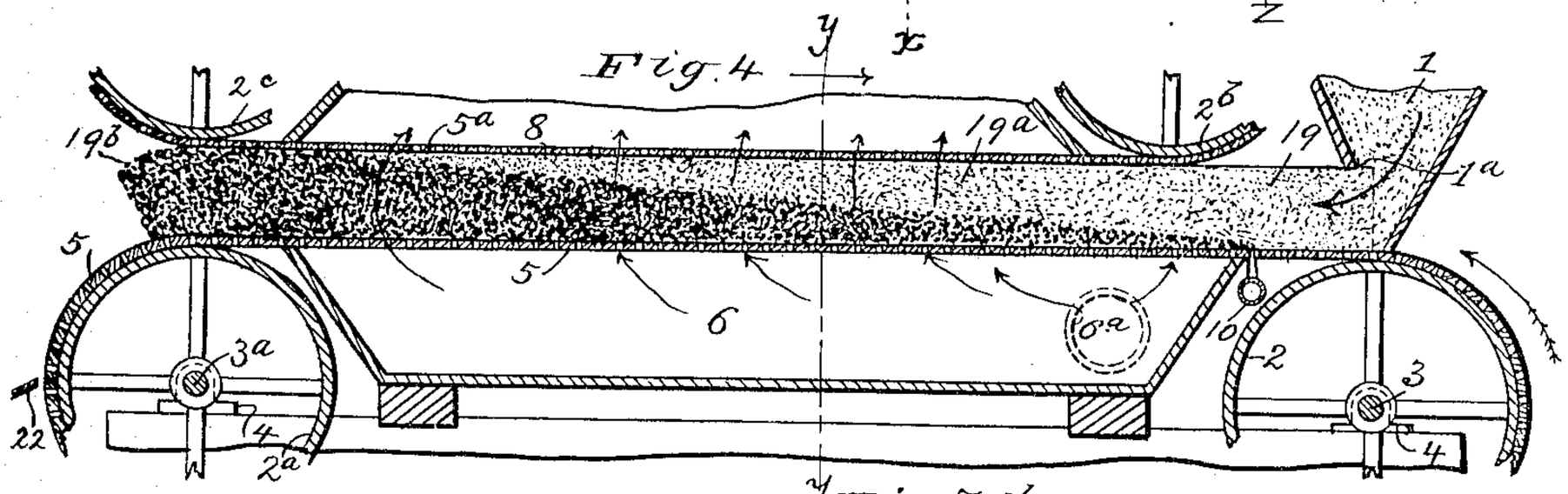


Fig. 3.

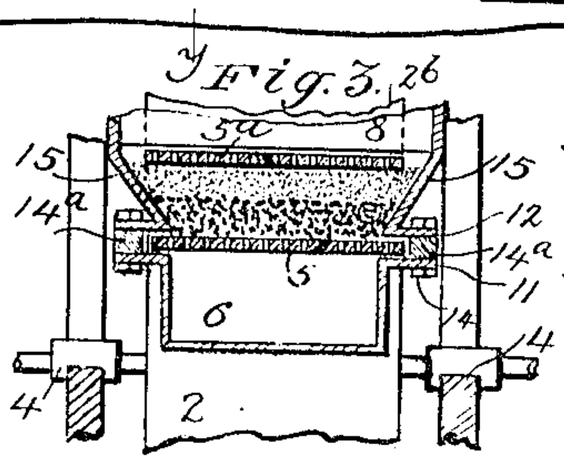


Fig. 6.

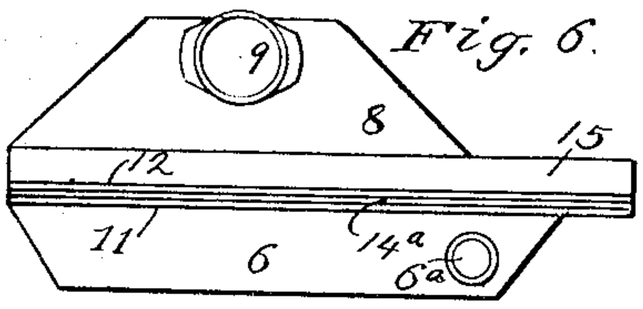


Fig. 7

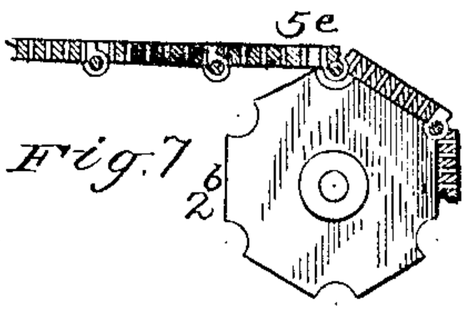


Fig. 5.

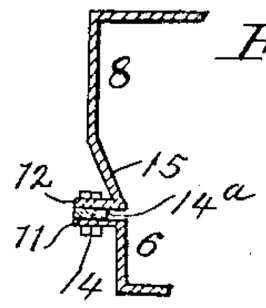


Fig. 8

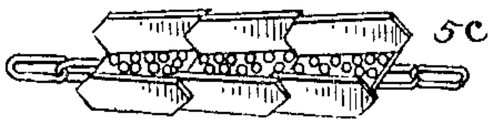


Fig 9

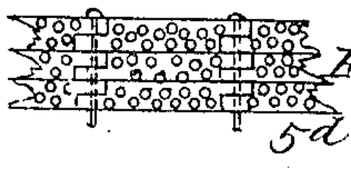
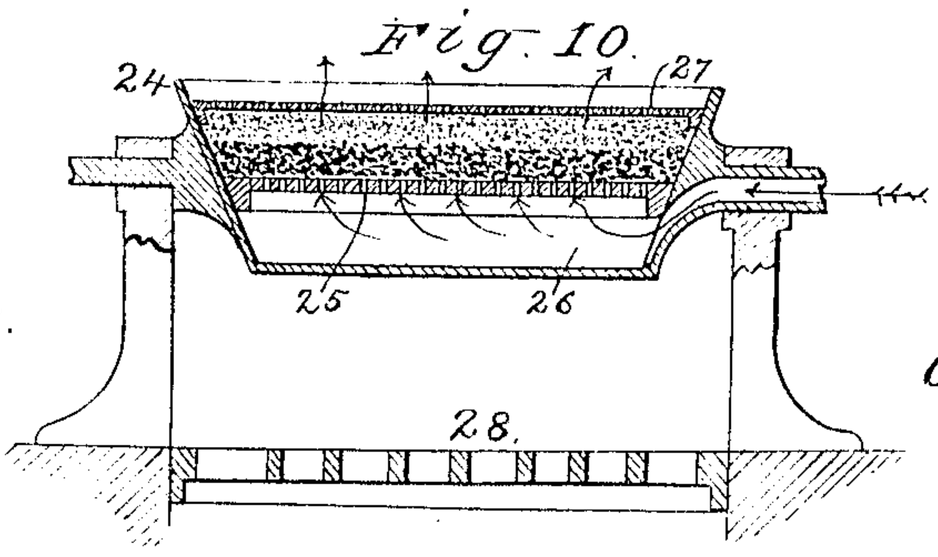


Fig. 10.



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UNITED STATES PATENT OFFICE.

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PROCESS OF ROASTING AND SINTERING ORE.

No. 916,396. Specification of Letters Patent. Patented March 23, 1909.

Application filed April 17, 1907, Serial No. 368,676. Renewed February 23, 1909. Serial No. 479,496.

To all whom it may concern:

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

This invention relates to improvements in processes for treating metal bearing materials, particularly ores of the metal sulfid class, said improvements pertaining somewhat especially to the process matters which are presented in the applications Serial Numbers 307431 and 428387, filed by myself jointly with Richard L. Lloyd on the 22nd of March, 1906, and on the 30th day of July, 1906, respectively. In the said applications we illustrated and described methods for disposing and supporting masses of ore and for treating them in the peculiar manner which we had devised, and also for transporting masses of ore during the treatment; the principal purposes being to desulfurize and sinter the ore more thoroughly and completely than had been done by any process or apparatus theretofore known by us. We therein called attention to the matters incident to and the results obtained by causing the combustion of the ore to advance downward through the mass under treatment, and causing the currents of air or combustion supporting gas, to also travel downward.

I have found it advantageous under some circumstances, and when treating ores of some characters, to cause combustion to advance in a direction other than directly downward, and to compel the air or combustion supporting gas to also move upward or horizontally. And in such case I have found it 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 earlier applications.

In the drawing I have shown one of many forms of apparatus which can be employed to carry on my present method of treatment; and in order that the process may be fully understood I will describe the mechanism shown in said drawings, as being typical in character, and in order that the steps in the process may be readily understood.

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 on a smaller scale. Fig. 4 is a partial longitudinal section on a larger scale on the line z z of Fig. 2. 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 ore support or holder.

In the drawings I have shown an apparatus for carrying out the process, but it is to be understood that it is merely typical in character, the method of treatment being such that it is independent of any particular form of apparatus.

In another application I have shown an apparatus similar to that herein and have therein presented claims for the novel features of such mechanism, restricting myself herein to the novel features in the process.

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^b. In Fig. 8 it is shown made of pans or pallets 5^c, with perforated bottoms, hinged or linked together or connected to endless chains. 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 by 19, 19^a, 19^b. That part indicated by 19 is still in its crude condition in which it is when stored in the hopper and for a short time after its delivery to the carrier.

19^a indicates the ore while traveling across

the region of treatment. At 19[b] 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 or other suitable air supplying mechanism through duct 6[a]. 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, 2[a].

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 and 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, 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 tends 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 supplemental restraining devices. These should be adapted to hold the ore particles in a state of quiescence and at the same time allow 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.

In Figs. 1 to 4, I illustrate a second endless carrier or belt formed of suitable material, as shown at 5[a], this being supported upon drums 2[b], 2[c], carried by shafts 3[b], 3[c], mounted in bearings at 4. By preference, the drums 2[b], 2[c] are so placed that the lower run or tangent portion of this belt 5[a] shall be of a length approximately equal 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 3[a]. 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 box or hood has similarly outwardly turned flanges 12 between which there are spacing devices, preferably pieces of asbestos 14[a], 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 1^a 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 5^a, 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 instantly thereafter. And as the particles from top to bottom through this portion at 19^a 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 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 2^a and 2^c. 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 stationary 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 matters incident to the method of treatment of the material do not depend essentially upon either of the particular forms of apparatus which are herein illustrated, but may be carried out by the employment of any of many instrumentalities, I do not herein claim any of the novel features incident to the apparatus which is illustrated and described, having made those the subject matter of claims in another application of even date herewith.

In another application, Serial No. 368,675, I have presented claims to the apparatus or mechanism which I have selected to illustrate the process disclosed in this case, and

while the claims herein pertain to the method of treatment, I reserve the right to present in said other application claims for the novel features of construction which are therein shown.

What I claim is:

1. The process for treating ores or metal bearing materials containing combustible elements, which consists in disposing the ore in a mass between two opposing supporting and retaining devices adapted to permit the entrance of air or gas through one and the exit thereof through the other, igniting the ore or the combustible contents thereof at places near one of the said supporting or retaining devices, passing air into the ore at points near the said supporting or retaining device and causing the opposite supporting or retaining device to hold the ore against agitation or disturbance at the places where the air or gases have their exit, substantially as set forth.

2. The process for treating ores or metal bearing materials containing combustible elements, which consists in placing a layer or mass of the ore upon a support or retaining device, igniting the ore in the lower part of the said mass or layer, causing air to pass upward through the lower part of the mass, applying to the upper part of the mass or layer a restraining device to prevent the agitation or disturbance of the particles thereof, and causing the escape of the gases of combustion or reaction from the stratum of ore adjacent to the said restraining device, substantially as set forth.

3. The process for treating ores or metal bearing materials containing combustible elements, which consists in causing a layer or stream thereof to move continuously in one direction, igniting the combustible elements of the ore along one of the surfaces of the said layer or stratum, applying to the said surface a supporting or retaining device adapted to move therewith, delivering to the said surface air or combustion supporting gas, applying to the opposite surface of the layer or stream a supplemental retaining device adapted to restrain the particles of ore from agitation or disturbance, and causing the escape from the last said surface of the gases of combustion or reaction, substantially as set forth.

4. The process for treating ores or metal bearing materials containing combustible elements, which consists in causing a layer or stream thereof to move continuously in one direction, igniting the combustible elements of the ore along one of the surfaces of the said layer or stream, applying to the said surface a supporting or retaining device adapted to move therewith, delivering to the said surface air or combustion supporting gas, applying to the opposite surface of the layer or stream a supplemental retaining device adapted to move therewith and to restrain the particles of ore from agitation or disturbance while it is undergoing treatment, substantially as set forth.

5. The process for treating ores or metal bearing materials containing combustible elements, which consists in causing a layer or stream thereof to move continuously in one direction, supporting the layer or stream against movement downward, restraining the particles of the said layer or stream against movement upward while it is advancing bodily, igniting the combustible elements of the layer or stream, supplying air or combustion supporting gas to the interior thereof, sintering the layer from the bottom to the top thereof, and removing the sintered masses from the end of the layer while the treating and sintering of the other parts thereof are being effected, substantially as set forth.

6. The process for treating ore or metal bearing materials containing combustible elements, which consists in causing a layer or stream thereof to move continuously in one direction, igniting the combustible elements of the ore while the bottom part and the top part thereof are held between supporting or retaining devices, causing air or combustion supporting gas to pass into and out from the interior of the said layer or stream to produce an internal combustion, sintering the ore of said layer or stream by the heat from said combustion, and removing the sinter from the end of the layer or stream, substantially as set forth.

7. The process for treating metal bearing materials containing combustible elements which consists in forming a suitable mass thereof, supporting the said mass substantially as set forth, whereby it can be transported bodily, causing internal combustion therein, supplying air to the lower part of the said mass and restraining the particles of the upper part of the mass from moving in relation to each other, whereby they are held quiescent while the mass is moving bodily and during combustion, substantially as set forth.

8. The process for treating metal bearing materials containing combustible elements, which consists in forming a movable mass of the materials, supporting the said mass upon a traveling support whereby it can be transported bodily, exposing the lower part of said mass, whereby air can enter igniting the mass, moving the said mass bodily and applying to the top of the mass a traveling holder or restraining device adapted to engage with the particles at the upper part of the mass and hold them in quiescence, substantially as set forth.

9. The method for treating metal bearing materials containing combustible elements, which consists in supporting and retaining a

mass of the ore between two opposing traveling devices, igniting the ore at the surface adjacent to one of said traveling supporting and retaining devices, and causing combustion supporting gas to pass through the said ore mass from the place of ignition to the opposite side, substantially as set forth.

10. The method for treating metal bearing materials containing combustible elements which consists in supporting the mass of the material between two ore supporting and retaining devices, igniting the said mass at or near one of the said supporting devices, causing air or combustion supporting gas to pass through the material toward the other supporting and retaining device, moving the mass bodily while sustaining combustion in its interior, and holding the particles of the mass against relative disturbance or agitation while moving bodily, substantially as set forth.

11. The method for treating metal bearing materials, which consists in passing the material in a continuous stream to a region of combustion, across said region and then from it, igniting the mass of the said material at one of its surfaces, causing combustion supporting air or gas to pass through the mass of the material and forming a solid stream of sinter from the stream of fines, substantially as set forth.

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

ARTHUR S. DWIGHT.

Witnesses:
HANS FISHER,
H. E. BUERKLIN.