A. S. DWIGHT.

APPARATUS FOR ROASTING AND SINTERING ORES.

APPLICATION FILED FEB. 2, 1910. RENEWED JUNE 21, 1912.

1,433,354. **Patented Oct. 24, 1922.**

2 SHEETS—SHEET 1.

Fig. 1.

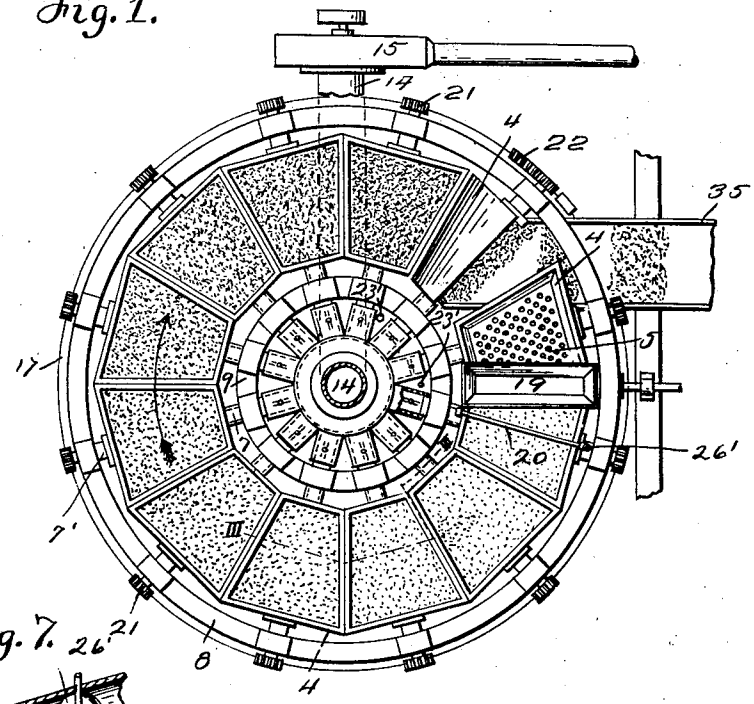


Fig. 7.

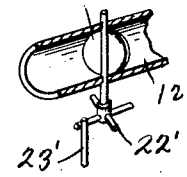


Fig. 2.

Witnesses.

Stuart Hilder

George E. Edelin

Inventor

Arthur S. Dwight

By H. H. Bliss.

Attorney

A. S. DWIGHT.

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Fig. 5.

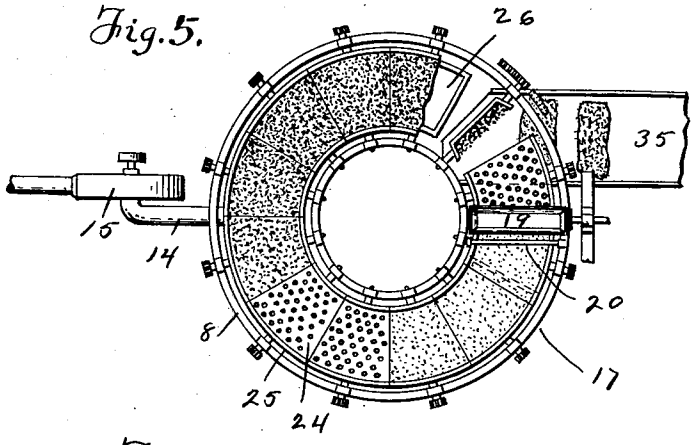


Fig. 6.

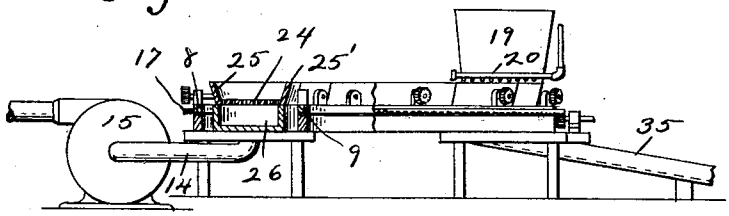


Fig. 3.

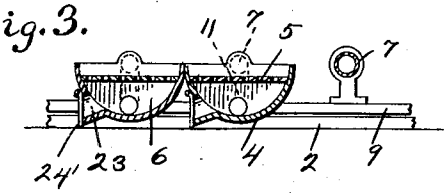
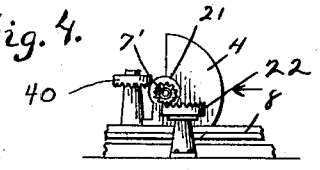


Fig. 4.



Witnesses

Stuart Hilder.

George E. Edelin

Inventor

Arthur S. Dwight

By H. H. Bliss.

Attorney

Patented Oct. 24, 1922. 1,433,354

UNITED STATES PATENT OFFICE.

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

APPARATUS FOR ROASTING AND SINTERING ORES.

Application filed February 2, 1910, Serial No. 541,505. Renewed June 21, 1912. Serial No. 705,100.

To all whom it may concern:

Be it known that I, ARTHUR S. DWIGHT, a citizen of the United States, residing at New York, in the county of New York 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 the art of sintering, agglomerating and roasting ores and other substances that are initially in a finely subdivided condition and contain or carry a combustible constituent, such for instance as sulphur-carrying copper ores; and has for its object to produce an apparatus by which such operations can be carried out, the apparatus being arranged to work automatically and being designed to occupy a minimum of space for a given capacity.

In my Patent 916,392 dated March 23, 1909, for Apparatus for roasting and sintering ores, there is shown, described, and claimed, a mechanism in which the grate or surface on which the ore is placed for sintering is in the form of a horizontal table of annular shape which is successively moved past a charging device, through a region where combustion takes place in the mass of ore, reducing it to a sintered condition, and thence to a place of discharge. In connection with such a table or ore-carrier, are means for causing a down draft of air through the ore to maintain combustion therein and means for controlling the flow of the air.

The present invention relates to apparatus similar in its generic features to that disclosed in the said application but different therefrom in the particulars to be hereinafter pointed out.

In the drawings,

Figure 1 is a plan view of one form of apparatus embodying the invention.

Figure 2 is a view of the same apparatus, the half of the machine to the right being in elevation, and the half to the left in vertical section.

Figure 3 is a vertical sectional view through three sections of the apparatus taken on the line III—III of Figure 1.

Figure 4 is a view in elevation illustrating one section of the apparatus tilted to discharge.

Figure 5 is a plan view of a different embodiment of the invention from that illustrated in the views already described.

Figure 6 is a view partly in elevation and partly in vertical section of the apparatus shown in Figure 5.

Figure 7 is a detail sectional view illustrating the cut-off valve in one of the air conduits and the means for operating it.

The foundation upon which the apparatus is supported is constructed with a pair of concentric circular tracks 2, 2, and a central base or foundation 3. Upon these tracks, and arranged to move in the annular path between them are arranged the separate sections that constitute the carrier or carriers for the ore while being treated to roast and sinter it. Referring to the form of invention illustrated in Figures 1, 2, 3 and 4, each carrier or ore-supporting section consists of a pot-like structure 4 carrying a grate or perforated support 5 for the ore and having below this support an air chamber 6. The form of the structure 4 may be variously modified to suit the various conditions met with in treating different materials, that shown consisting of a cast metal structure having integral side and bottom walls and provided with supports for the grate near its upper edge, the parts of the side walls above the grate constituting side walls or flanges for holding in place the loose ore that may be delivered upon the grate. Each pot-like structure 4 is provided with a pair of trunnions 7, 7′, these being preferably disposed to coincide with a line radial to the entire movable ore-carrying structure.

The trunnions are mounted in circular carrying rings 8, 9, arranged to lie directly over the tracks 2 and be supported thereby. Interposed between the tracks and carrying rings are balls or other suitable means for reducing friction. The inner trunnion 7 is hollow and communicates on the one side with the air chamber 6, through an air box or pipe 11, and on the other side with a radially disposed tube or pipe 12 leading to a central drum 13 which in turn is connected

by a suitable conduit 14 with the suction fan 15 or other means for inducing a flow of air downward through the masses of ore upon the grates, into the air chambers 6, through the radial tubes 12 and thence into the central drum. The central part of the apparatus, including the central drum or air chamber 13 is supported upon the central portion, 3, of the base or foundation where there is provided a circular track and guiding support 16 for the drum.

The apparatus thus far described constitutes a horizontally disposed carrier formed of separate pivoted sections each section connected with the air-moving apparatus and the whole adapted to move as a unit in a substantially horizontal plane about a common center. Various means for giving motion to this movable structure may be adopted. I have represented one of the carrying rings, the outer one 8, as being provided with a cog rack or gear 17 with which engages a suitable driving mechanism, only the pinion 18 of which is shown in the drawings.

The separate ore-carrying sections, whether of the pot-like structure shown in Figures 1 to 4 or of other construction, as will be later described, are preferably so arranged as to come close together edge to edge. Several advantages are incident to this arrangement: in the first place it enables a grate surface to be employed practically co-extensive with the annularly moving structure; and in the second place, it permits the use of a continuous feed, since, there being no open spaces between sections, there is no danger of the ore falling between them and becoming wasted even though fed continuously.

19 indicates a feed hopper. This may be of any usual or improved construction and may be provided with means for regulating the depth of the bed of ore delivered to the grates, and for leveling the same; but as these features do not relate to the present invention they are not illustrated.

20 represents the igniter for starting the combustion in the ore mass. It is located close to the feed hopper, and it, too, may be of any usual or preferred construction. As shown it consists of a gas pipe provided with burner tips or jet orifices, located across and close to the upper surfaces of the ore masses as they pass beyond the feed hopper. The apparatus is so operated that combustion takes place in the ore while it is moving through practically three quadrants of the path followed by the pots, during which time each ore-carrying section of the apparatus is connected with the fan or other air-moving apparatus. By the time the apparatus has moved this distance, that is, three-fourths of its circuit, the roasting and sintering operations are completed, the entire ore mass from top to bottom being reduced to a sintered biscuit or cake, after which the connection with the air-moving apparatus is cut off and the discharge of the sintered ore takes place. This discharge is effected by the tilting of the individual sections of the ore carrier.

Various means may be provided for automatically effecting the discharge of the ore. But one, however, is shown.

21 is a gear pinion supported by an extension of the trunnion 7 of each section. 22 is a gear rack with which the pinion 21 comes into engagement as the section approaches the place of discharge and which causes a rotation of the pinion and a corresponding tilting of the carrier. This rotation may be complete or partial, as desired, depending upon the length of the rack 22. If partial it should be sufficient to insure a discharge of the sintered material on the grate, and the center of gravity of the section 4 should be so disposed that the latter will automatically come back to position when the pinion escapes the rack. If, however, it should be found desirable to positively return the section to working position a rack 40 situated as indicated in Fig. 4 may be employed for that purpose.

When the sectional ore carriers are of the construction illustrated in Figures 1 to 4 they may be freely suspended and no provision need be made for preventing them from swinging or tilting while the sintering operations are taking place.

As more or less of the fine ore will sift through the grates 5 and fall into and collect in the air chambers below, it is well to provide means for cleaning these chambers. For that purpose one of the side walls of each air chamber 6 is perforated, as indicated at 23, and over each perforation is a door 24'. This door preferably hangs close to the face of the opening when the pot is in working condition, and is held tightly closed by the pressure of the external air when the chamber is connected with the suction apparatus; but when the pot is tilted for discharge, as represented in Figure 4, the door opens and the fine material which has fallen into the air chamber may freely pass out through the opening.

The sintered ore as discharged may be delivered upon a grizzly or chute 35, or other conveying apparatus.

The mechanism by which connection between the fan or other suction device and the air chambers 6 is successively made and broken may be of various kinds, that which is herein shown being similar to the corresponding mechanism illustrated in the aforesaid Patent No. 916,392. 26' represents a valve, of which there is one arranged in each radial pipe or tube 12, this valve being adapted, when turned in one position,

to cut off communication between the outer end of the pipe and the air box device on the one side and the central air drum 13 and fan 15 on the other side. The stem of each valve is provided with a set of tappets 22′ arranged to engage with stationary pins 23′, 23′ located in the path of the tappet arms 22′ as they are carried around with the traveling frame of the sintering apparatus. One of these pins, 23′, is located just in advance of the igniter 20 and operates to successively set the valves in position to open communication between the air chambers 6 and the suction apparatus. The other stop pin 23′ is set in position to successively close the valves just before the sections of the ore-carrier come to the place of discharge.

In Figures 5 and 6 there is shown a form of the invention which in some respects is more simple than that just described. Here the independent sections 24 of the ore carrier are flat and are provided along their front and rear edges with curved flanges 25, 25′ that serve to confine the ore delivered to the carrier sections, and the latter are perforated to form a grate. They meet edge to edge and between adjacent sections there are no separating flanges, walls or partitions. The sections 24 are pivotally supported in the carrying rings 8, 9, and are arranged to be tilted to break up and discharge the cake of sintered material, the means for effecting the tilting of the sections and their discharge being similar to those already described for tilting the pot-like sections of the other form of the invention, or different therefrom if found desirable.

26 indicates a stationary air trunk or chest open at the top and connected with a suction fan or other air-moving device. The air chest is of a shape corresponding with the horizontal table of the ore carrier formed of the sections 24, and the latter move over the open end thereof, the sections being adapted to engage with the edges of the air chest, and when in such engagement to form close joints that prevent the entrance of air into the chest, when the fan is in operation, except through the perforations in the ore carriers. The air chest or trunk is not co-extensive with the ore-supporting surface of the movable carrier, a segment of the chest being omitted opposite that part of the path of the ore carrier where the tilting of the sections takes place.

There are certain advantages incident to the construction illustrated in Figs. 1, 2 and 3 wherein each independently tiltable holder is formed with continuous edge walls that operate to define the limits of the sintered product formed therein and separate it from the product formed in each other holder, since much less power is required to tilt the holder to discharge the sintered mass than where the tilting of the section or holder requires not only the lifting of the mass of sintered material that it carries but also the breaking or rupture of that mass from the sintered material carried by another section, as is the case when the sintered product extends continuously from holder to holder, as in the apparatus shown in Fig. 5.

In an earlier application for Patent, to-wit, Ser. No. 368,675, filed April 7, 1907, on which has issued Patent #1,021,509 dated March 26, 1912, I illustrated and described an ore roasting mechanism having an ore receptacle mounted in such way as to be available in attaining the purposes of the present invention. The mechanism in said earlier application comprises means whereby the ore is not only supported in such way that air can be caused to pass through its mass, but is so held that the particles of its mass are held in quiescence during the treatment. This may be accomplished either by supporting each ore-mass on or against a perforated holder and causing the air to enter the mass and move through it toward said support or holder; or it can be accomplished by placing the ore between two elements both of which will permit the passage of air, for example, placing it between a perforated wall or grate upon one side and a retainer on the other side, such as a perforated or reticulated screen-like sheet, these insuring that not only shall the air enter the mass without disturbing it, but shall escape therefrom, (together with the gaseous products of combustion) without agitating or disturbing the particles at the region of escape.

And in my Patent No. 916,397 dated March 23, 1909, I have illustrated and described devices which I have sometimes employed for this purpose and which can be utilized in an apparatus such as comes within the claims and descriptions hereof; in said Patent 916,397 the fine ore being sustained or carried upon a perforated bottom or grate and having upon the opposite surface of the mass larger ore particles, or particles of furnace charge of such nature and so arranged that during the sintering action they serve to restrain the neighboring particles or parts of the mass from that agitation or disturbance which, as is now well known, is the factor seriously interfering with the sintering of fines.

And I wish it to be understood that the subject matter presented in the claims and description in this application includes the use of any of such details, so far as concerns the individual ore receptacles which I herein support on a common carrier, in relation to which carrier they are independently movable for such purposes as effecting a complete discharge of their contents.

The operation of the apparatus is as follows:

The hopper 19 being filled with the loose ore to be roasted and sintered, the horizontal table is slowly rotated and the fan or other air-exhausting mechanism started. The ore is fed in a thin layer upon the sections of the horizontal carrier and is ignited at the upper surface shortly after leaving the hopper. The roasting and sintering of the ore then takes place, the burning of the combustible content of the ore mass gradually progressing from the upper surface downward toward the grate, combustion being mantained by a liberal supply of air drawn through the ore mass by the air-moving apparatus. The speed of movement of the ore carrier should be such that the combustion shall be completed and the ore sintered from surface to surface just before it arrives at the place for tilting the sections and discharging the material thereon. This discharge in both forms of the apparatus illustrated is effected automatically, although the sections might be tilted by hand if this were desired. The tilting movement of one section relative to another not only inclines the grate surface of the section tilted so that the loose material thereon will be discharged by gravity, but also tends to break up and loosen the sintered material this being especially true in a construction of apparatus like that illustrated in Figures 5 and 6 where the cake or mass of sintered ore is practically continuous from section to section of the ore support.

While I have in this case, in describing the invention and the operation thereof, referred to the roasting and sintering of a sulfid ore, it will be understood that I do not intend thereby to limit the useful applications to which the machine or apparatus described may be put, to the treatment of an ore of this character, since the invention is well adapted for the treatment of other material which is initially in a finely subdivided condition and requires to be roasted, calcined, sintered or agglomerated through the action of an internal combustion taking place within the mass being treated.

What I claim is:

1. In an apparatus for roasting and sintering ores by combustion within the ore masses, the combination of an ore carrier arranged to move in an endless path that is located in a substantially horizontal plane, and formed of separate sections individually movable for discharging the sintered material, and means for causing air to support combustion to pass through the ore mass in a downward direction.

2. In an apparatus for roasting and sintering ores by combustion within the ore masses, the combination of an ore carrier formed of a series of separate pivotally supported sections arranged to move in an endless path and located in a substantially horizontal plane, means for causing air to pass in a downward direction through the ore masses supported on the sections, and means for effecting a tilting of the sections successively to discharge the sintered product.

3. In an apparatus for roasting and sintering ores by combustion within the ore masses, the combination of a series of independent ore-supporting sections, a rotary, substantially horizontal carrier in which the said sections are pivotally supported, each section being arranged to be tilted independently of the others for discharging the sintered product thereon, and means for causing combustion to take place in the ore masses in a downward direction while being carried by the said sections and before they reach the place where they are discharged.

4. In an apparatus for roasting and sintering ores by combustion within the ore masses, the combination of a series of independent ore-supporting sections and a rotary substantially horizontal carrier in which the sections are pivotally supported, each section being arranged to be tilted independently of the others for discharging the sintered product, the axes on which the sections turn being substantially radial with reference to the said rotary carrier.

5. In an apparatus for roasting and sintering ores by combustion within the ore masses, the combination of a series of independent ore-supporting sections, and a rotary substantially horizontal carrier in which the sections are mounted, each section being arranged to be tilted independently of the others for discharging the sintered product, and the sections when in working position meeting edge to edge.

6. In an apparatus for roasting and sintering ores, the combination of a pair of concentric tracks, a rotary substantially horizontal carrier supported on the tracks, and a series of independent ore-supporting sections pivotally mounted in the said carrier and arranged between the said tracks, each section being arranged to be tilted independently of the others for discharging the sintered product therefrom.

7. In an apparatus for roasting and sintering ores, the combination of a pair of concentric tracks, a rotary substantially horizontal carrier comprising a pair of carrying rings supported on the tracks, and a series of independent ore-supporting sections pivotally supported in the said carrying rings and each free to be tilted independently of the others for discharging the sintered product.

8. In an apparatus for roasting and sintering ores, the combination of a pair of concentric tracks, a rotary substantially horizontal carrier supported on the tracks,

a series of independent ore-supporting sections pivotally mounted in the said carrier, each section being free to be tilted independently of each other one, an air trunk located at the center of the said carrier, air connections between the said air trunk and each section arranged to cause air for supporting combustion to pass through the ore masses on the sections, and air suction apparatus connected with said central trunk.

9. In an apparatus for roasting and sintering ores, the combination of a rotary substantially horizontal carrier, a series of ore supports of pot-like construction mounted therein, each ore support being free to be tilted independently of the others for discharging, and means supported by the carrier for causing air to pass in a downward direction through the ore masses supported respectively by the said separate ore carriers.

10. In an apparatus for roasting and sintering ores, the combination of a rotary carrier, a series of independent pot-like structures pivotally supported therein, a grate in each pot-like structure disposed so as to receive a body of ore upon its upper surface, and having an air chamber below the grate, air suction apparatus connected with each air chamber and arranged to draw air in a downward direction through the ore mass supported on the grate, and means for effecting a tilting of the said pot-like structures successively at a certain place in their path of rotation to discharge the ore supported on the grates.

11. In an apparatus for roasting and sintering ores, the combination of a rotary horizontal carrier and a series of ore supports pivotally supported therein, each support comprising a grate and an air chamber below the grate, the wall of the air chamber being perforated to permit cleaning thereof, a door covering each opening, and air moving apparatus connected with each chamber.

12. In an apparatus for roasting and sintering ores, the combination of a rotary carrier, a series of independent pot-like receptacles pivotally mounted therein, each pot carrying a grate on which a mass of ore is supported and below which is an air chamber, and air moving apparatus connected with each chamber, the adjacent pots coming together edge to edge, and the axes about which they turn being radial to the rotary carrier.

13. In an apparatus for roasting and sintering ores, the combination of a rotary substantially horizontal carrier, a series of independent ore-supporting sections mounted in the carrier, each section being free to be tilted independently of the others, the axes on which the sections turn being substantially radial to the rotary carrier, means for feeding ore to the ore-supporting sections, means for causing air to pass through the ore to support combustion in the ore masses, and means for tilting the sections to effect a discharge of the ore after it has been sintered.

14. In an apparatus for roasting and sintering ores by combustion within the ore masses, the combination of a frame the parts of which are rigidly united and which is arranged to move in a circular path, and individual ore supports mounted on the said frame, each movable independently of the others for discharging the sintered material, and means for causing air to pass through the ore mass in a downward direction to support combustion.

15. In an apparatus for roasting and sintering ores by combustion within the ore masses, the combination of a frame the parts of which are rigidly united and which is arranged to move in a circular path, and a series of ore receptacles independently and movably mounted in the said frame, means for inverting the said receptacles or moving them relatively to the frame to discharge their contents, means for supplying the ore to the receptacles, and means for causing air to move through the ore masses in the receptacles, the said receptacles being provided with means for restraining the particles of ore from relative movement while subjected to the air, substantially as set forth.

16. In an apparatus for treating ore by combustion within the mass, the combination of an ore carrier arranged to move in a curved path about an axis and formed of separate sections individually movable for discharging the mass after treatment, and means for causing air to support combustion to pass through the mass in a downward direction.

17. In an apparatus for treating ore by combustion within the mass, the combination of a series of independent ore-supporting sections arranged edge to edge when in working position and concentrically disposed about an axis, each section being tiltable independent of the others for discharging the ore mass that it supports, and means for causing the sections to move about the said axis.

18. In an apparatus for treating ore, a holder for the ore while being treated tiltably supported and comprising a grate or pervious support on which a mass of ore rests, and an air chamber below the grate, the wall of the air chamber being perforated to facilitate cleaning, and a door covering the opening, in combination with air moving apparatus connected with the said chamber.

19. In an apparatus for sintering and agglomerating metalliferous material that is initially in a fine condition and contains a combustible constituent, a series of inde-

pendent tiltable holders each having a perforated support for the material which support is disposed between an upper chamber adapted to receive a layer of material and a lower closed gas chamber the material chamber and gas chamber remaining intact whenever the holder is tilted, means connected respectively with the gas chambers of the said holders for causing currents of air to pass transversely through the layers of material upon the said supports, a single igniting device for setting fire to the combustible constituent of the material at the exposed surfaces of the layers in the holders the holders and the igniter being movable one with reference to the other, and means for operating the holders independently of each other to cause them to tilt and to discharge their contents.

20. In an apparatus for sintering or agglomerating metalliferous material that is initially in a fine condition and contains a combustible constituent, independent holders for the material, arranged in a series and each having a pair of supporting trunnions on which it is tiltable, one of the trunnions being hollow, air-moving apparatus connected respectively with the said hollow trunnions and arranged to cause air to be passed through the material, and a single igniter for setting fire to the combustible constituent of the material at the exposed surfaces of the charges in the holders, the holders and igniter being movable one with reference to the other, and the holders being independently tiltable to discharge their contents.

21. In an apparatus for sintering or agglomerating metalliferous material that is initially in a finely subdivided condition and contains a combustible constituent, holders arranged in a series and each having its individual fixed axis of support, continuous edge retaining walls and a perforated bottom, and being open at the top, a single igniter arranged to set fire to the combustible constituent of the charges of material in the several holders, the holders and igniter being movable one with reference to the other, and means for independently tilting the holders to discharge their contents after treatment, each holder being arranged to have its edge walls define the limits of the sintered product formed therein and cause it to be separate and distinct from the product of each other holder.

22. An apparatus for sintering metalliferous substances that are initially in a fine condition, comprising a tiltable and bodily movable receptacle having a pervious support, means for moving the receptacle along a prescribed path, means for causing air to pass transversely through the support and the material resting thereon, a gear wheel connected with the receptacle and arranged on the axis of the support about which it tilts, means for operating the gear as the support is moved through a particular part of its path to cause the receptacle to be tilted and an igniter arranged to act temporarily upon the contents of the receptacle at the exposed surface thereof.

23. An apparatus for sintering metalliferous substances that are initially in a fine condition, comprising a series of independent tiltable receptacles, means for moving the receptacles in a prescribed path, means for filling them with material, means for causing air to pass transversely through the material held in the said receptacles, a gear wheel connected with each receptacle and located on the axis about which the receptacle turns, means for successively operating the gears to tilt the receptacles to discharge their contents after being treated, as the receptacles successively reach a particular part of the path in which they move and a single igniter arranged to temporarily act upon the material in each receptacle.

24. In an apparatus for sintering or agglomerating metalliferous material that is initially in a fine condition and contains a combustible constituent, a series of independent tiltable holders each having a perforated support for the material which support is disposed between an upper chamber adapted to receive a layer of material and a lower closed gas chamber, means connected respectively with the gas chambers of the said holders for causing currents of air to pass transversely through the layers of material upon the said supports, and a single feeder arranged to deliver material successively to the said holders, and means for operating the holders independently of each other to cause them to tilt and discharge their contents after treatment.

25. In an apparatus for sintering and agglomerating metalliferous material that is initially in a fine condition and contains a combustible constituent, a series of independent tiltable holders each having a perforated support for the material which support is disposed between an upper chamber adapted to receive a layer of material and a lower closed gas chamber, means connected respectively with the gas chambers of the said holders for causing currents of air to pass transversely through the layers of material upon the said supports, a single igniting device for setting fire to the combustible constituent of the material at the exposed surfaces of the layers in the holders, the holders and the igniter being movable one with reference to the other, and means for operating the holders independently of each other to cause them to tilt and to discharge their contents.

26. In an apparatus for sintering or agglomerating metalliferous material that is initially in a finely subdivided condition and

contains a combustible constituent, holders arranged in a series and each having a fixed axis of support, continuous edge retaining walls and a perforated bottom, and being open at the top, a single igniter arranged to set fire to the combustible constituent of the charges of material in the several holders, the holders and igniter being movable one with reference to the other, and means for independently tilting the holders to discharge their contents after treatment, each holder being arranged to have its edge walls define the limits of the sintered product formed therein and cause it to be separate and distinct from the product of each other holder.

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

ARTHUR S. DWIGHT.

Witnesses:

IRENE A. RIVIERE,

C. M. STANLEY.