A. S. DWIGHT.

PROCESS OF ROASTING AND SINTERING ORE.

APPLICATION FILED MAY 28, 1907. RENEWED FEB. 23, 1909.

916,397. Patented Mar. 23, 1909.

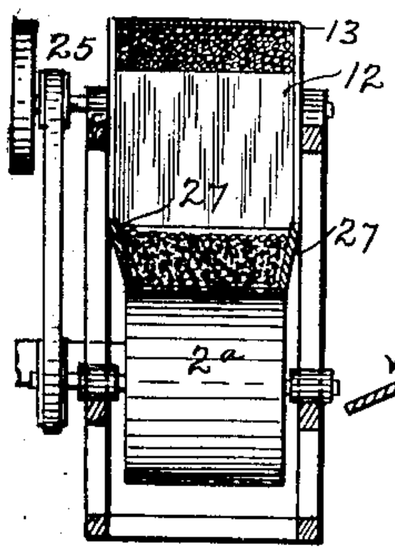
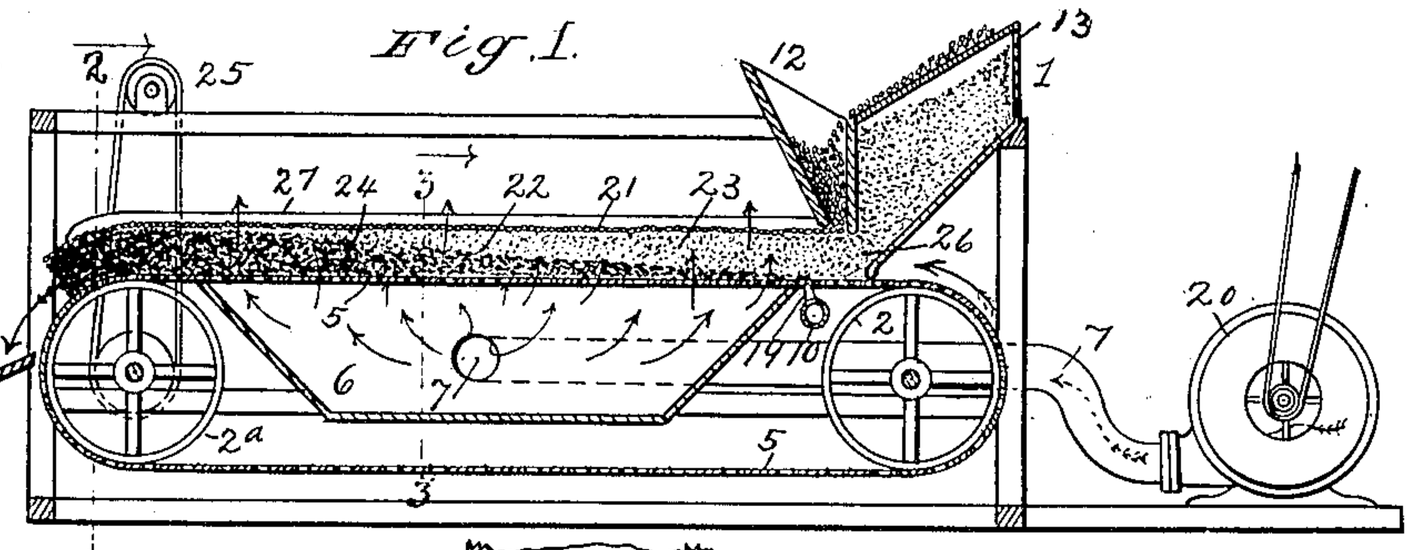


Fig. 2.

Fig. 1.



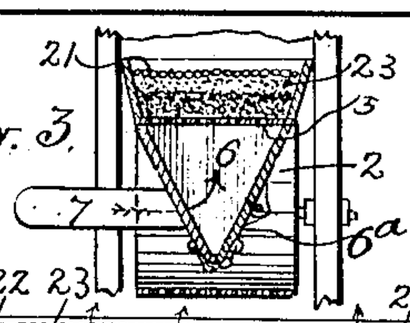


Fig. 3.

Fig. 4.

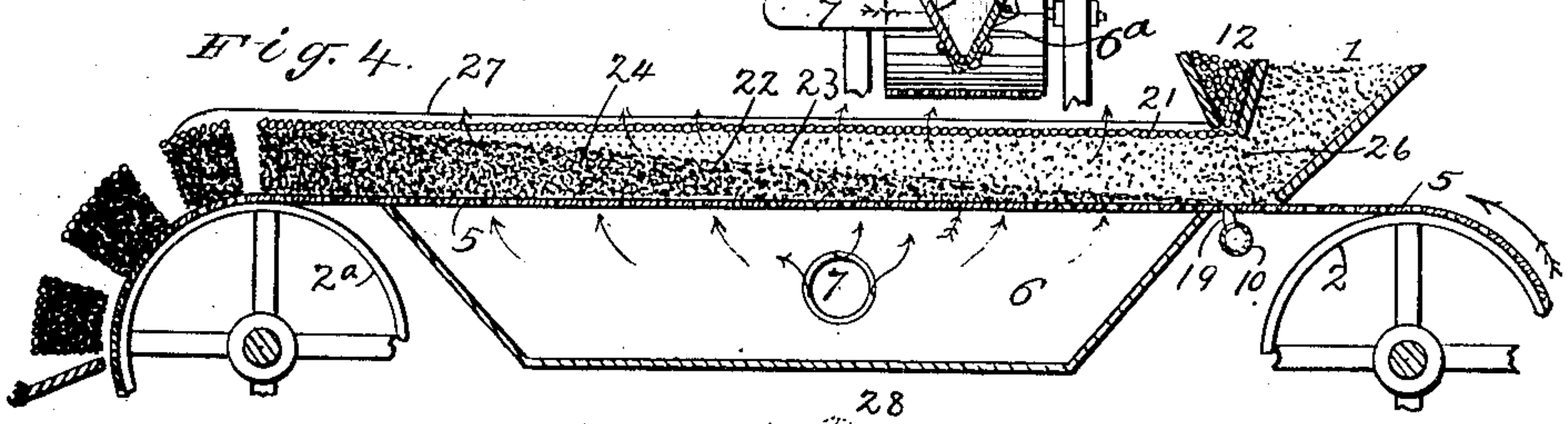


Fig. 5.

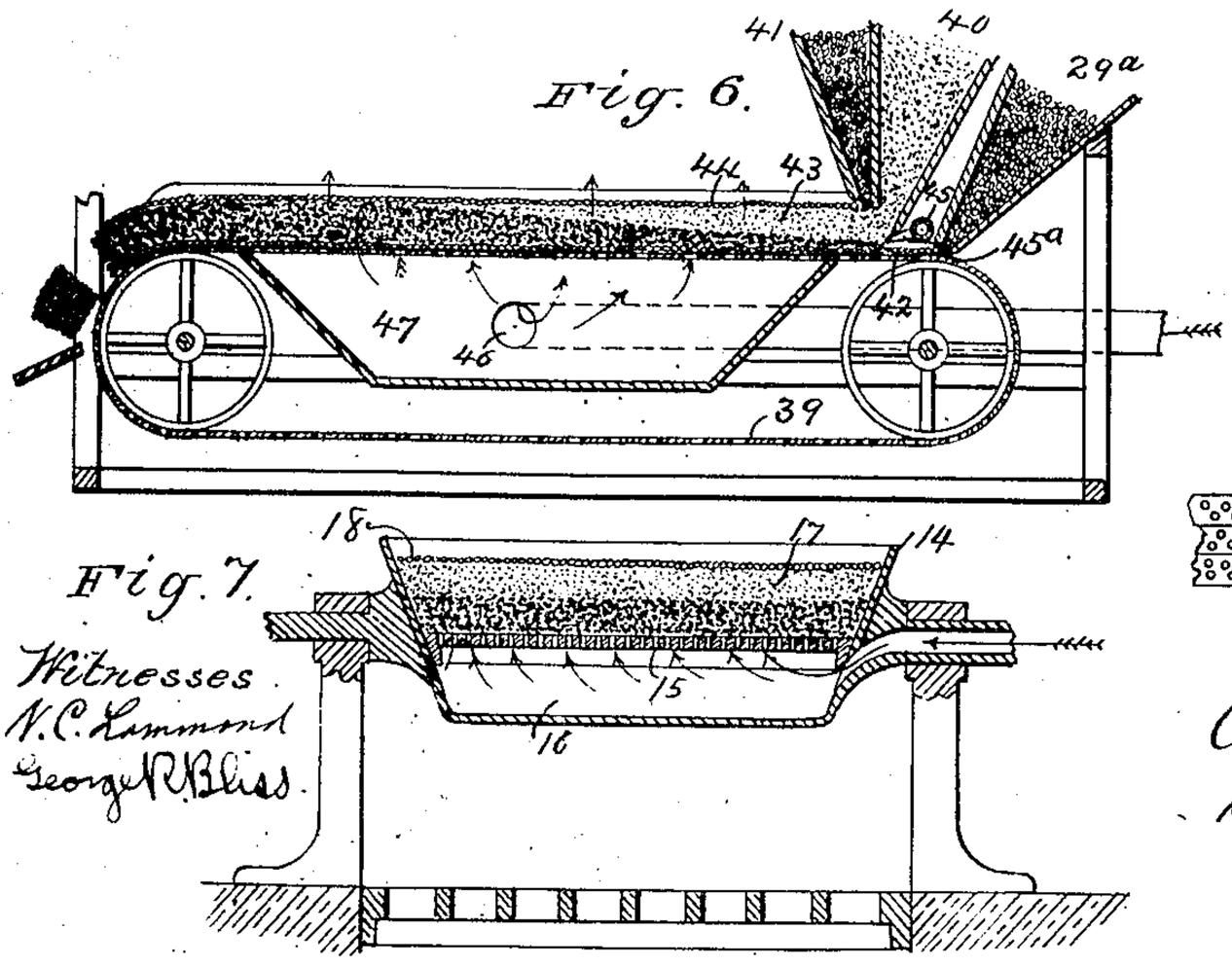


Fig. 6.

Fig. 7.

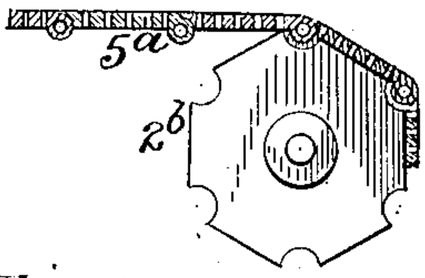


Fig. 8.

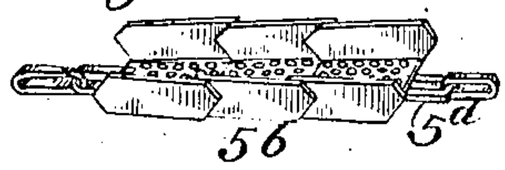


Fig. 10.

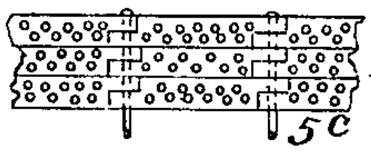


Fig. 9.

Witnesses
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UNITED STATES PATENT OFFICE.

ARTHUR S. DWIGHT, OF JOLIET, ILLINOIS, ASSIGNOR TO FRED BENNITT, TRUSTEE OF JOLIET, ILLINOIS.

PROCESS OF ROASTING AND SINTERING ORE.

No. 916,397. Specification of Letters Patent. Patented March 23, 1909.

Application filed May 28, 1907, Serial No. 376,138. Renewed February 23, 1909. Serial No. 479,497.

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 the processes for treating metal bearing materials, particularly ores of the metal sulfid class, these improvements relating to processes such as are presented in the applications Serial Numbers 307431 and 328387, filed by myself jointly with Richard L. Lloyd on the 22nd day of March, 1906, and on the 30th day of July, 1906, respectively. In the said applications were illustrated and described a number of devices for supporting and transporting masses of ore to be treated and for carrying on the treatment in such way that the desulfurizing and sintering of the ore could be done more thoroughly and completely than had been attained by any apparatus or process theretofore known. Therein were described the generic features as well as some specific matters incident to the invention.

I have devised certain improvements which I have found to be applicable under many circumstances in the treatment of ores of the class referred to, and they are herein presented.

In order that the present improvements may be fully understood I present herewith drawings which will illustrate some of the numerous forms of devices that can be employed in carrying out the process.

Figure 1 is a longitudinal section of mechanism which can be used to hold ore and transport it while it is being subjected to the treatment which characterizes my present improvement. Fig. 2 is a cross section on the line 2—2 of the apparatus shown in Fig. 1. Fig. 3 is a cross section on the line 3—3 of Fig. 1. Fig. 4 is a longitudinal section showing some of the same parts that are presented in Fig. 1, but on a larger scale. Figs. 5, 6 and 7 are sectional views respectively illustrating modifications in the method of treating the ore. Figs. 8, 9 and 10, are detail views showing different forms of carrier mechanism.

It will be understood that the illustrations and the drawings are more or less diagrammatic and conventional in character.

Fig. 1 illustrates a mechanism in which use is made of an endless horizontal carrier; and Fig. 4 is a sectional view of some of the parts in Fig. 1 on a larger scale. The carrier is indicated as a whole by 5. It may be made in any suitable way, for example it may be constructed of flat bars 5^a hinged as shown in Fig. 8; or it may be similar to what are known as pan conveyers, as in Fig. 10, that is, conveyers formed in sections 5^b which are secured to a chain or chains 5^b; or it may be built up of link bars, 5^c as shown in Fig. 9. But as above remarked the conventional illustration in Figs. 1, 2, 3 and 4 is sufficient to convey an understanding of how the invention can be carried out. The conveyer 5 is mounted upon wheels, pulleys, or drums, as at 2, 2^a. The ore supporting part or floor of the conveyer is provided with perforations or passages for the free movement of air or gas. At 1 a hopper is provided, it being adapted to contain the "fines" or fine ore materials which constitute the principal part of the mass that is to be treated. This ore escapes through the mouth at 26 directly above the conveyer, and is deposited upon the latter in a layer or stream 23 of suitable depth and width. The vertical sides of the mass may be sustained or confined in any preferred way, as for instance by walls 27. At present for purposes of description and illustration it may be assumed that the materials to which reference is made are typified by galena or the sulfids of copper or iron, separate or mixed. It is desired to submit this material to such treatment that it will not only be completely desulfurized but also sintered throughout, that is to say that after the desulfurizing there will be produced a coherent sintered mass in suitable condition for immediate use in the blast furnace. For the desulfurizing of the ore in the layer or stratum 23 on the conveyer the sulfur elements are ignited, and the combustion thus started is continued until the sulfur bodies are entirely oxidized. The igniting can be effected at 10 where is situated a horizontally arranged gas pipe with jet orifices, this pipe being arranged on lines transversely to the conveyer and immediately below the upper run thereof at points near the hopper mouth

26, the orifices being arranged so that the flame jets 19 impinge upon the lower surface of the stratum of ore as it advances from the hopper. The combustion thus started is maintained, as the stream or layer 23 advances with the conveyer, by means of an air supply furnished from the box at 6. This is shown as being situated between the upper and lower runs of the conveyer 5. Air is supplied to this distributing box through the trunk or duct 7 which communicates with a fan or pressure device 20. The box 6 may have a hinge section 6[a] to permit cleaning. As the layer or stream of ore advances over the air supply mechanism the combustion in the ore mass is supported and it gradually rises as shown at 22 until the upper surface of the layer is reached, the sinter being shown at 24. As is fully set forth in earlier application filed by myself solely and said applications filed by myself jointly with R. L. Lloyd, it has been discovered that it is practically impossible to effect the complete sintering of a mass of ore of this character at the time of or immediately after the desulfurizing thereof, if the currents of air which support the combustion are passed through the mass in such way as to travel toward and escape at an unrestrained surface. And in the said applications I have made provisions for effecting the holding of the ore particles in quiescence at the place where the air or the gases of combustion or reaction escape. One of the objects of the present invention is to provide an effectual restraining of the ore without requiring the supplemental metallic or mechanical parts heretofore provided by me, accomplishing it in such way that the means used for this purpose can remain in the sinter or be withdrawn therewith and subsequently introduced into the smelting furnace if required. I have found that the particles of the fine ore in the stratum at or near the upper surface, where air and gases escape, can be satisfactorily held in place until they are effectually sintered, by means of a layer of large particles or lumps of ore of the same consistency or chemical constitution as the fines themselves. And the manner of using these lumps or blocks as a restraining means for the fines is illustrated in the said Figs. 1 to 4.

12 indicates a hopper supplemental to that at 1, and preferably located directly adjacent thereto. In this hopper there is placed a store of the lumps or blocks of larger sizes of the ore, and it is so placed that a thin layer 21 of these passes from its lower end and is deposited evenly and smoothly upon the top of the layer or stream of fines or more or less pulverulent mass that is delivered from the hopper 1. At 13 I arrange a screen above the hopper 1 upon which the material can be centrally placed which screen acts to separate the fines from the coarser particles, the former dropping through the screen into the hopper 1, and the latter passing over the screen and being caught in the hopper 12. Of course it will be understood that suitable adjusting devices are employed for increasing or decreasing the flow of the coarser material as occasion demands. These larger blocks or particles of the sulfid ore rest upon and are distributed over the top surface of the stream or layer 23 of fines. As is now well known, the air which is forced upward through an ore mass of this sort tends to lift and agitate the particles of the fines near the upper surface of the mass, and this agitation, disturbance and displacement prevents the sintering of a large percentage of the material. And it has also been found that if this disturbing action can be prevented, a complete sintering of the entire body from the bottom to the top can be attained. When the restraining or holding means are such as here described, the sinter produced from the fines to a greater or less extent unites with the lumps or blocks 21 of larger size which have been placed on top of the stream and the mass is ready for introduction to the smelting furnace. The union, however, of the upper stratum with the sinter of the lower stream is not essential, as it is common practice to introduce to the smelting furnace not only fines from the roasting furnace, but more or less of the raw sulfid ore in lumps or blocks, this depending upon the metallurgical conditions, the chemical constituents and the like. And not only is it true that such a component of the charge for the blast furnace as has just been described can be used as a retaining device for properly holding the fines while being desulfurized and sintered, but I have also found that other comparatively coarse ingredients of the furnace charge can be likewise used.

In Fig. 5 I have shown an apparatus which is adapted to deliver a stratum of crushed lime-rock to the lower surface of the layer or stream of fines, the quantity being of such proportion that it can be introduced with the desulfurized mass in the smelting furnace. Here there is a hopper 26 for the fines and a hopper 29 for the lime rock or similar material. Use is made of a conveyer 30 substantially similar to that above described, mounted on the wheels or drums at 31, 32. The layer 33 of lime rock or similar material is interposed between the conveyer and the sulfid ore and serves to distribute the air to the bottom surface of the layer or stream 34. The upper surface of the layer is not provided with a retaining device because in this case the air is drawn downward from the top through the bottom into the box 35, from which it is exhausted by any suitable apparatus such as the fan at 38. The ore is ignited by the gas jets supplied from the pipe at 37 situated above the upper sur-

face of the ore. In this case the combustion travels downward from the top toward the bottom, the line of combustion being shown at 38.

In Fig. 6 I have shown how the steps carried on by an apparatus like that in Fig. 5 can be combined with those performed by devices such as shown in Fig. 1. 29ª is a hopper for supplying a layer 42 of lime rock or equivalent material to the conveyer 39. 40 is a receptacle for supplying a layer or stream 43 of the sulfid fines, and from the hopper or receptacle at 41 a stratum or layer 44 of blocks or lumps of sulfid ore is delivered and deposited upon the top of the fine ore. Igniting flames 45ª are supplied from the gas pipe at 45, the gas jets here impinging upon the combustible ore at the lower part of the stream 43 just as it leaves the hopper 40, and immediately before coming to the paths of the forced air currents. In this case the air is forced upward under pressure, it being delivered through the pipe 48 to the box 47 from which it passes to the ore mass and upward through the latter. It will be understood that so far as concerns the sulfurizing and the sintering and the holding in place or keeping in quiescence the particles at the upper part of the mass it is not necessary to have an ore holder which moves or advances during the operation.

In Fig. 7 I have shown an apparatus for treating stationary masses of ore in the way referred to. The stationary holder is indicated by 14, it being provided with an ore support 15 which has numerous air passages and below which there is an air receiving and distributing chamber 16. Air is supplied under pressure to this chamber, and it is forced upward therefrom through the ore mass at 17. Upon the top of the fines I place a stratum of the coarser particles or lumps of ore or a layer of lime rock or the like, as shown at 18, this as above described preferably being part of the charge which is subsequently introduced into the smelting furnace. Here as in the mechanism above described the result attained is that the coarser particles at the top supply a weight for holding down in position the finer particles in the upper stratum of the mass, and they are held in such way that at the time of the generation of the heat, say by oxidation and desulfurization, they are in proper condition and in proper relative positions for quickly and readily sintering together to form large cakes or blocks ready for introduction into the furnace.

What I claim is:

1. The process for treating metal bearing materials containing combustible elements, which consists in arranging a mass of the material in fine condition between two oppositely arranged holders or retainers one of which consists of particles of rock or ore relatively larger than the particles of fines, igniting the combustible elements of the mass, and allowing combustion supporting gas to pass through the mass of fines and through the two opposite retaining means, substantially as set forth.

2. The process for treating metal bearing materials containing combustible ingredients, which consists in arranging a mass of the material in fine condition upon a holding device, igniting the ore at the surface of the mass adjacent to the said holding device, causing combustion supporting gas to enter the mass at the surface of ignition, applying to the opposite surface of the mass a series or stratum of particles of ore or rock relatively larger than the particles of fines, whereby the stratum of fines along the said opposite surface are restrained or held against agitation and disturbance during combustion and sintering, substantially as set forth.

3. The process for treating metal bearing materials containing combustible elements, which consists in arranging a mass of the material while in relatively fine condition upon a holder or retainer, placing in contact with the mass an opposing retainer composed of a series or stratum of particles separable from each other and relatively larger than the particles of the fines, igniting the combustible elements of the mass at points near one of the said retainers, causing combustion supporting gas to pass through the mass from the side thereof adjacent to the place of ignition and toward and through the opposite retainer, and maintaining the particles of the fines in quiescence during the combustion and sintering, substantially as set forth.

4. The process for treating metal bearing materials containing combustible elements which consists in arranging a mass of the material in fine condition between two oppositely arranged holders or retainers, one of which consists of particles of rock or ore relatively larger than the particles of fines, igniting the combustible elements of the mass, allowing combustion supporting gas to pass through the mass of fines and through the two opposite holders or retainers, sintering the mass of fines and causing the relatively larger particles of one of said retainers to adhere to or agglomerate with the sintered fines, substantially as set forth.

5. The process for treating metal bearing materials containing combustible elements, which consists in arranging a mass of the material in fine condition between two oppositely arranged holders or retainers, igniting the combustible elements of the ore, causing combustion supporting gas to pass through the mass and through the two opposite retaining means, and causing one of the retaining means to adhere to or agglomerate with the sinter, substantially as set forth.

6. The process for treating metal bearing materials containing combustible elements, which consists in arranging a mass of the material while in relatively fine condition upon a holder or retainer, igniting the combustible elements of the mass at points near that side of the mass adjacent to the said retainer, causing combustion supporting gas to pass through the mass, placing in contact with the mass an opposing retainer composed of a series or stratum of particles separable from each other and relatively larger than the particles of the fines, and arranging them substantially as set forth to restrain the particles of the fines from agitation or disturbance, substantially as set forth.

7. The process for treating metal bearing materials containing combustible elements which consists in arranging a mass of the materials in fine condition between two oppositely arranged holders or retainers, one of which consists of particles of rock or ore relatively larger than the particles of fines, moving the said retainers in one direction continuously, across a region of combustion, causing currents of combustion supporting gas to move transversely to the path of the retainers across the region of combustion, igniting the combustible elements of the mass, and sintering the mass of fine material, substantially as set forth.

8. The process for treating metal bearing materials containing combustible elements, which consists in arranging a mass of the material while in fine condition substantially as set forth whereby a current or currents of combustion supporting gas are permitted to pass through the mass, holding the said mass between two retainers adapted to restrain the particles of the fines against agitation and disturbance, one of the said retainers being formed of particles of material adapted to be introduced into the blast furnace, igniting the combustible elements in the mass, causing internal combustion in said mass between the said retainers, and supporting the combustion by the said current or currents of gas, substantially as set forth.

9. The process for treating sulfid ores containing combustible elements which consists in arranging a mass of the ores while in fine condition substantially as set forth whereby a current or currents of combustion supporting gas are permitted to pass through the mass, holding the said mass between two retainers adapted to restrain the particles of the fines against agitation and disturbance, forming one of the said retainers of particles of sulfid ore relatively larger than the particles of the fines, igniting the sulfur elements in the mass, causing internal combustion in said mass between the said retainers and supporting the combustion by the said current or currents of gas.

10. The process for roasting sulfid ores containing combustible elements, which consists in arranging a mass of the ore while in fine condition substantially as set forth whereby a current or currents of combustion supporting gas are permitted to pass through the mass, holding the said mass between two retainers adapted to restrain the particles of the fines against agitation and disturbance, one of the said retainers being formed of particles of material adapted to be introduced into the blast furnace, igniting the combustible elements in the mass of fines, and causing internal combustion thereof between the said retainers.

11. The process for roasting sulfid ores containing combustible elements which consists in arranging a mass of the ore while in fine condition substantially as set forth whereby a current or currents of combustion supporting gas are permitted to pass through the mass, holding the said mass between two retainers adapted to restrain the particles of the fines against agitation and disturbance, forming one of the said retainers of particles of material relatively larger than the particles of fines and adapted to be introduced into the blast furnace, igniting the sulfur elements in the mass, causing internal combustion in said mass between the said retainers and supporting the combustion by the said current or currents of gas.

12. The process for roasting and sintering sulfid ores containing combustible elements, which consists in arranging a mass of the ore while in fine condition in contact with a holder or retainer, igniting the combustible elements of the ore at points near the said retainer, causing a combustion supporting gas to pass through the ore fines, placing in contact with the mass a stratum or series of particles of the sulfid ore relatively larger than the particles of the fines and arranging them substantially as set forth to restrain the particles of fines from agitation and disturbance during the roasting and sintering, substantially as set forth.

13. The process for treating metal bearing materials preparatory to introducing them into a blast furnace, which consists in forming a stratum or stream of one of the ingredients of the blast furnace charge, applying to the said stratum or stream a supplemental stratum or stream of a second ingredient for the blast furnace charge, permitting a current or currents of air or gas to pass through the said strata or streams, raising the heat in the interior of the said materials to a temperature causing the particles of the said strata or streams to adhere or agglomerate one with the other, and finally forming from the agglomerated materials, blocks or cakes for introduction into the blast furnace, substantially as set forth.

14. The process for treating metal bearing materials preparatory to introducing them

into a blast furnace, which consists in forming a stratum or stream of one of the ingredients of the blast furnace charge containing combustible ingredients, applying to the said stratum or stream a supplemental stratum or stream of a second ingredient for the blast furnace charge, permitting a current or currents of combustion supporting gas to pass through the said strata or streams, igniting the said combustible elements, causing internal combustion in one of the said strata or streams, raising the heat by internal combustion in the interior to the sintering temperature and causing the particles of both of the said strata or streams to agglomerate by the said sintering, and finally forming from the agglomerated materials blocks or cakes for introduction into the blast furnace, substantially as set forth.

15. The process for treating metal bearing materials preparatory to introducing them into a blast furnace, which consists in forming an advancing stream or stratum of one of the ingredients of the blast furnace charge containing the combustible ingredients, applying to the said stratum or stream while it is advancing a supplemental stream or stratum of a second ingredient of the blast furnace charge, moving the said strata or streams across a region of combustion, causing currents of combustion supporting gas to pass through the said strata or streams transversely to their paths of advance, igniting the combustible elements, and raising the heat by internal combustion to the sintering temperature and causing the particles of the stratum or stream containing the combustible elements to be sintered and agglomerated, substantially as set forth.

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

ARTHUR S. DWIGHT.

Witnesses:
G. E. SEYMOUR,
SOL SEKULSKY.