G. G. VIVIAN.

PROCESS FOR SINTERING ORE.

APPLICATION FILED NOV. 13, 1909.

950,798.

Patented Mar. 1, 1910.

2 SHEETS—SHEET 1.

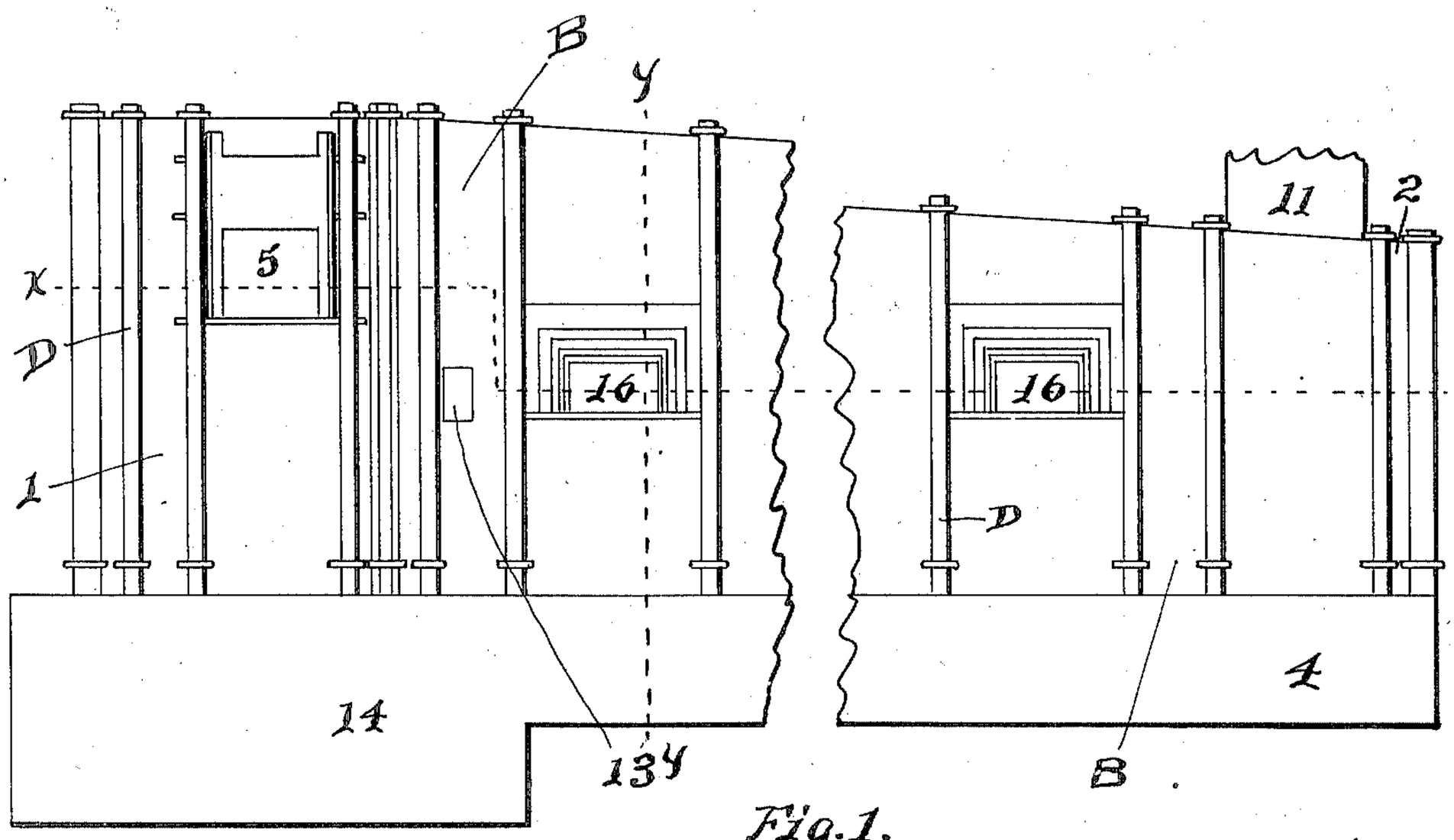

Fig. 1.

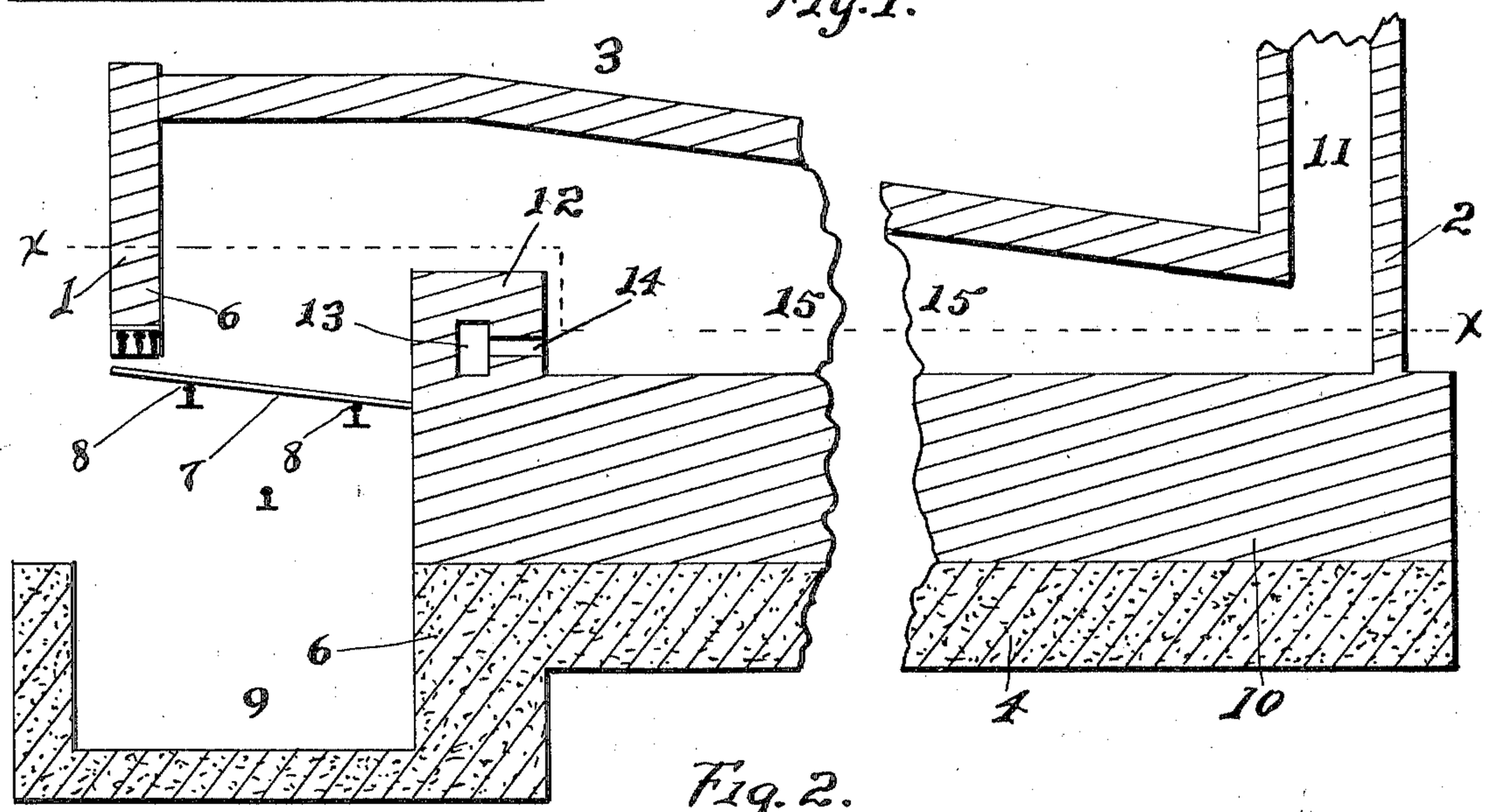

Fig. 2.

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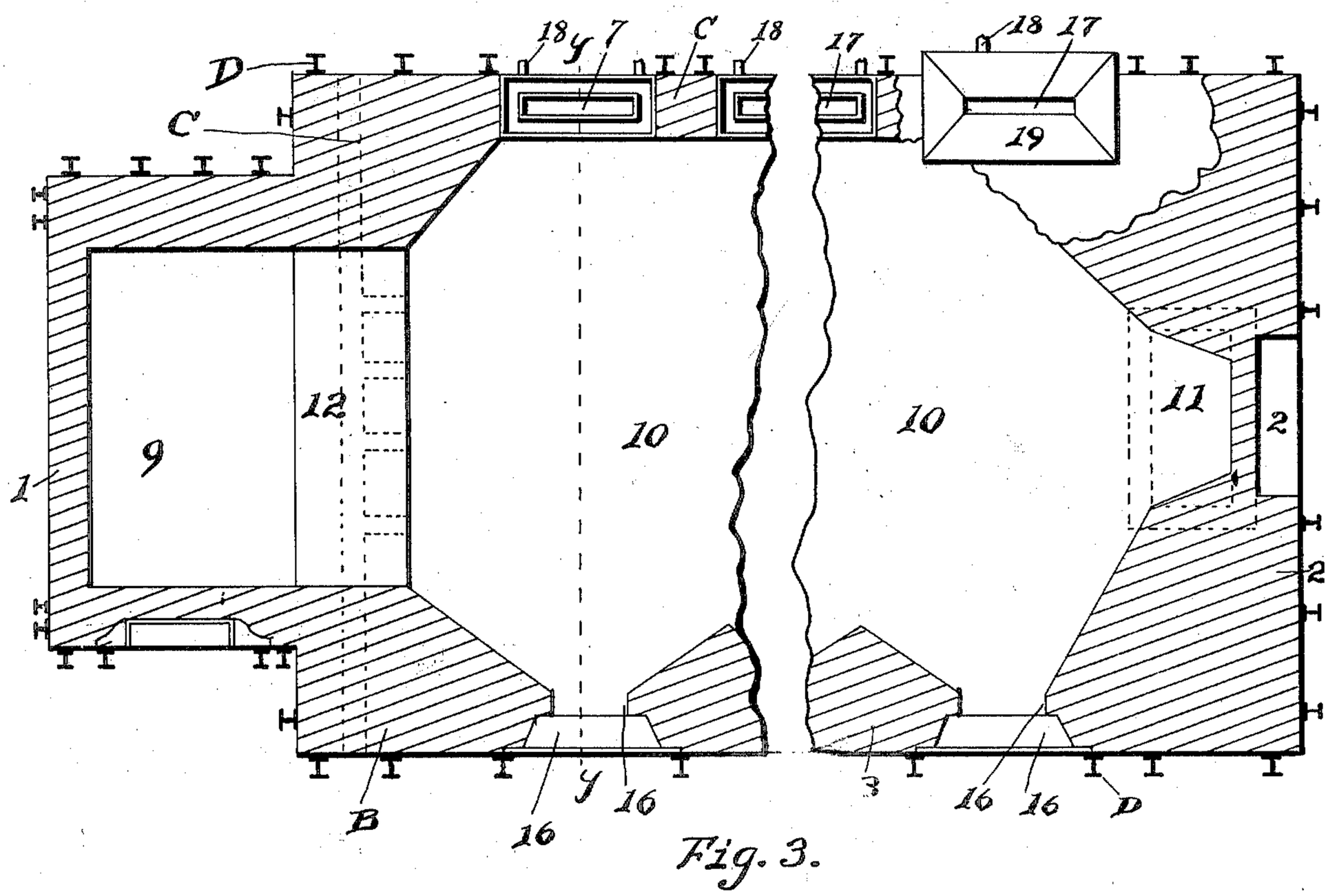
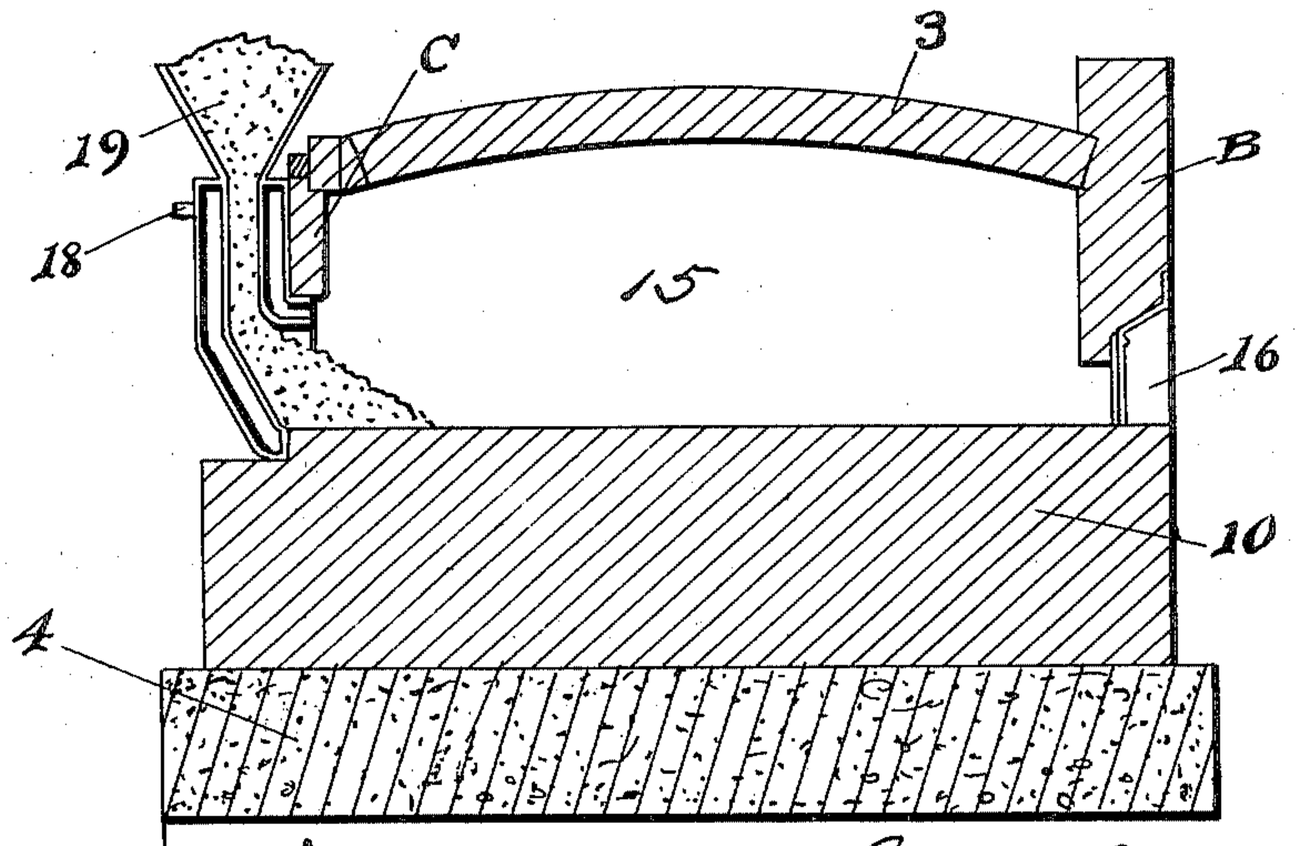


Fig. 3.

Fig. 4.



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UNITED STATES PATENT OFFICE.

GEORGE G. VIVIAN, OF TINTIC, UTAH, ASSIGNOR OF ONE-HALF TO JESSE KNIGHT, OF PROVO, UTAH.

PROCESS FOR SINTERING ORE.

950,798. Specification of Letters Patent. Patented Mar. 1, 1910.

Application filed November 13, 1909. Serial No. 527,920.

To all whom it may concern:

Be it known that I, GEORGE G. VIVIAN, a citizen of the United States, residing at Tintic, in the county of Juab and State of Utah, have invented certain new and useful Improvements in Sintering Ores, of which the following is a specification.

My invention relates to improvements in ore smelting processes, and the objects of my invention are to provide an ore treatment for finely crushed ore, flue dust and concentrates which will conserve the fuel elements of the material and put it into the best possible condition for the subsequent smelting operations, which treatment will result in a saving of fuel; will require a less amount of barren material to be added to the charge; will result in increased capacity of the furnace, and enable material to be treated in a blast furnace that could not otherwise be profitably treated therein. I attain these objects by means of my process, which may be carried into practice in a sintering furnace which I have invented especially for use in my present process, and which is illustrated in the accompanying drawings, in which,

Figure 1, is an outside elevation, medial portions cut away. Fig. 2, is a vertical, longitudinal section, medial portions cut away. Fig. 3, is a horizontal section, on line *x x* Fig. 1, medial portions cut away. Fig. 4, is a transverse vertical section, on line *y y* Fig. 1.

It is not my intention to limit myself to the particular furnace shown, as any device which will carry out the process may be used.

My process comprises the sintering of the material and the burning out of deleterious matter, which treatment results in a more complete and thorough separation of the metallic values from ores by the subsequent smelting treatment in another furnace, than any roasting and smelting processes known by me to be in use, especially is this so when ores are crushed into small pieces and carry considerable fine material; and in the smelting of concentrates and flue dust.

As is well known, it is the practice of miners to ship ores to custom sampling plants and to have their ores sampled before selling to the smelter. In the sampler the ore from the mines is crushed to a very fine mesh, and the mass is divided and subdivided, samples are taken, pulverized and assayed to determine the value of the shipment, consequently a large proportion of the ore received by the smelter is finely crushed and sampled ore. In addition to this ore product, a large tonnage of concentrates is shipped to the smelter from custom and private concentrating plants. These concentrates comprise the ore product that has been obtained by crushing crude ore from the mine, and grinding it to from 20 to 80 mesh, and running it over the concentrating machines, which are adapted to separate the mineral particles from the gangue matter. These separate mineral particles are called concentrates, and are shipped to the smelters to be smelted by themselves, or mixed with the crude ore from the mines and samplers and smelters In addition to this, in the treatment of ores through blast and other furnaces a large product called flue dust accumulates in flue chambers, which product is exceedingly fine, and carries relatively the same percentage of values and gangue matter as the ore under treatment. In some smelting plants this flue dust is mixed with milk of lime, making a plastic mass, which is then pressed into briquets and dried; which briquets yet retain all the deleterious matter. These briquets are again sent through the smelter mixed with other ore for treatment; but it is found that a greater percentage of dust rises from the briquets than from an equal amount of ore, which dust is again to be caught, briquetted and smelted. I accomplish this sintering treatment in some cases by taking advantage of the sulfur elements of ores. It is well known that the second atom of sulfur in the bi-sulfid of iron (FeS_2) is held so feebly that it cannot be fully utilized as fuel in the pyritic or blast furnace, as it passes off in the upper part of the furnace and causes irregularities and much trouble in various ways in the fusing of the charges in such furnaces, which sometimes results in clogging up the charge, and making a hot top with its attendant loss in the metallic value, and also in burning off a large portion of the sulfur, which may be used for fuel The sintering treatment for this class of ore is for the purpose of

driving off this second and useless atom of sulfur, controlling the heat applied to the ore, and arresting the process of roasting at such point; and thereby conserving the sulfur in the ore, and then withdrawing the ore from the furnace, so that when it is charged into the blast furnace the monosulfid of iron (FeS) can be kept intact until it reaches the smelting zone, where it meets the blast, and advantage is taken of the oxidation of the remaining sulfur and the iron to carry the smelting process to the end. The ore can be fed hot into the blast furnace, but it must be cooled sufficiently just before or after it leaves the sintering furnace to stop further chemical change, in order to reserve the balance of the sulfur for the final operation of smelting in the smelting zone of the blast furnace.

The roasting of ores for the purpose of getting rid of the sulfur and oxidizing the metals is not new, but the arresting of the treatment at the point of time when the ore reaches a sticky or pasty condition, and the eliminating from the ore an exact portion of sulfur while retaining the remaining atom of sulfur, is new. The ore when in the form of concentrates, frequently exceedingly fine, is so unsuited to any form of smelting, especially in the pyritic or blast furnace, that a sintering roast is necessary to agglomerate it into lumps which is the most suitable condition for it to be put in, to be fed to the smelting furnaces, as it prevents practically all loss from the floating away of the finer dust portion of the dry ore with the draft through the flues and chimney of the furnace. The sintering of the flue dust instead of briquetting it has the advantage of a saving of time, the putting the dust into better form physically, the burning off of objectional matter and preventing a reaccumulation of dust from the smelting of briquets made from flue dust.

I have found in practice that in the process patented to me August 6th, 1907, by Letters Patent No. 862683 under the title of Automatic ore smelting process for reverberatory furnaces, and as well in all furnaces, that a sintering treatment should be given to the finely crushed ores, such as are now shipped from mines to smelters, concentrates, and flue dust, in order to secure, enlarged capacity for the smelter, reduction in cost of smelting, loss in flue dust, a saving of fuel, and economical treatment in blast furnaces of concentrates and flue dust. My experience proving that while my improved reverberatory furnace is all that could be desired as a separator of the metallic values and the molten ore, yet it, in common with all reverberatory furnaces is an expensive type of furnace in which to fuse the ore, and as the blast furnace is not capable of sintering ores, I have invented and illustrate herewith a furnace especially designed and adapted to practically and economically affect a sintering treatment of ores, concentrates and flue dust preparatory to being taken to a blast furnace. This furnace enables me to give the treatment desired by my process which is in the nature of a roast, but it differs from the common manner of roasting ores in that the ore is heated only hot enough to become sticky, and to agglomerate into irregular lumpy masses.

I am aware of the fact that other roasting and sintering devices have been used, but the product from which does not meet the requirements of the subsequent smelting treatment in blast furnaces.

In my furnace, A is the foundation, B and C are the side walls which are suitably supported by I beams D.

1 is the front end wall, 2 the rear end wall, 3 is the roof and 4 the bottom. At the front end 1, is provided a fuel feeding door 5, and in the same end is fitted the fire box 6, which consists of grate bars 7, suitably supported on I beams 8, beneath which is the ash pit 9. A horizontally placed hearth 10, is built extending from the said fire box 6, to rear or other end of the furnace. In the rear end of the furnace is built the flue 11, leading to the stack. On the front end of the hearth 10 is the bridge wall 12, within which is formed a horizontal cold air conduit 13, with openings 14, therefrom into the heat chamber 15 of the furnace. This cold air conduit 13, extends through each side wall. In the side wall B, are fitted working doors or openings 16, through which openings the attendants work and manipulate the ore under treatment. Opposite said openings 16 in the side wall C, is fitted the ore chutes 17. Said ore chutes are water-jacketed by allowing water to circulate around the chutes by means of pipes 18, one of which is ingress and the other egress. Each ore chute is fitted with an ore hopper 19.

The operation of my sintering furnace and therein carrying out my process is as follows: Fire is started in the fire box and the ore to be treated is fed into the ore hoppers 19, (which are kept filled at all subsequent steps of the treatment,) which material will by gravity assume the position shown in Fig. 4. The attendant will open one of the openings 16 and by means of rabbles gently draw and spread some of the ore over the hearth; and in this manner cover, through said openings, all of said hearth. When sufficient heat has been absorbed by the ore so spread, to render it sticky, a door is opened and the sticky ore is removed. During such removal the ore receives some manipulation. After the removal it is dumped on the floor. It is then while hot spread out in a thin sheet or mass to chill which chilling arrests further chem-

ical change and renders it brittle and easily broken into convenient sized lumps for feeding into a smelting furnace.

Having thus described my process, I claim and desire to secure by Letters Patent.

1. A process for treating ore, which consists of subjecting the ore to the action of heat, while the ore is at rest, sufficient to cause it to become sticky, then removing the ore from the heat and manipulating it to form irregular lumps, as and for the purpose described.

2. A process for treating ore, which consists of subjecting the ore to the action of heat while the ore is at rest within a furnace having a lateral draft over the ore to cause it to become sticky, then removing the ore from the furnace before the heat elements in the ore are consumed, and manipulating it to form nodules, as and for the purpose described.

3. A process for treating ore, which consists of spreading the ore in a thin layer on the hearth within a furnace, subjecting it while so spread to the action of heat sufficient to cause it to become sticky, then removing the ore from the heat and manipulating it to form nodules.

In testimony whereof I have affixed my signature in presence of two witnesses.

GEORGE G. VIVIAN.

Witnesses:
G. B. BLAKELY,
Jos. F. SIMMONS.