E. A. MATHERS.

ORE SMELTER.

APPLICATION FILED JULY 3, 1906.

916,176.

Patented Mar. 23, 1909.

3 SHEETS—SHEET 1.

Fig. 5

Fig. 1

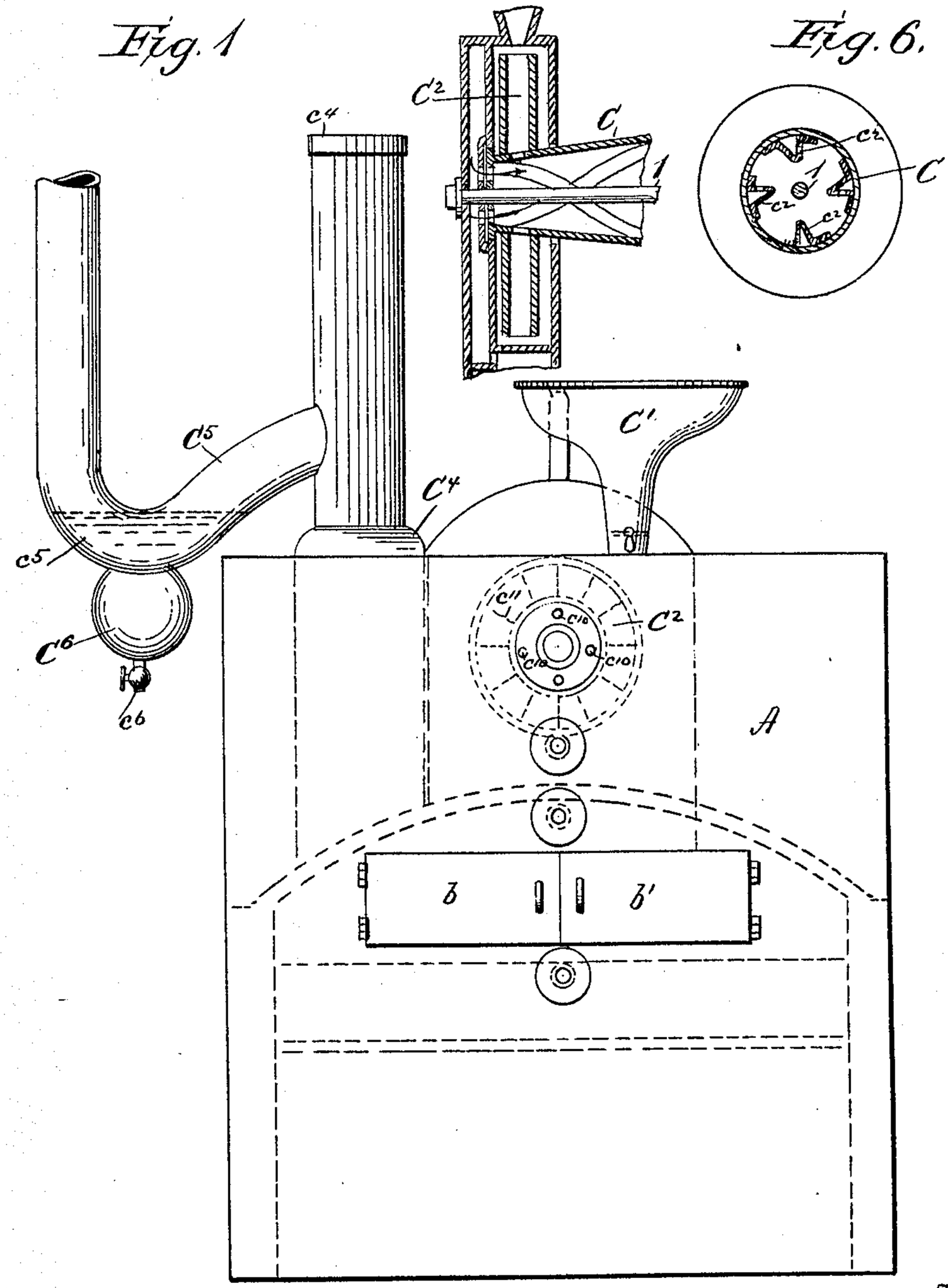

Fig. 6.

Witnesses
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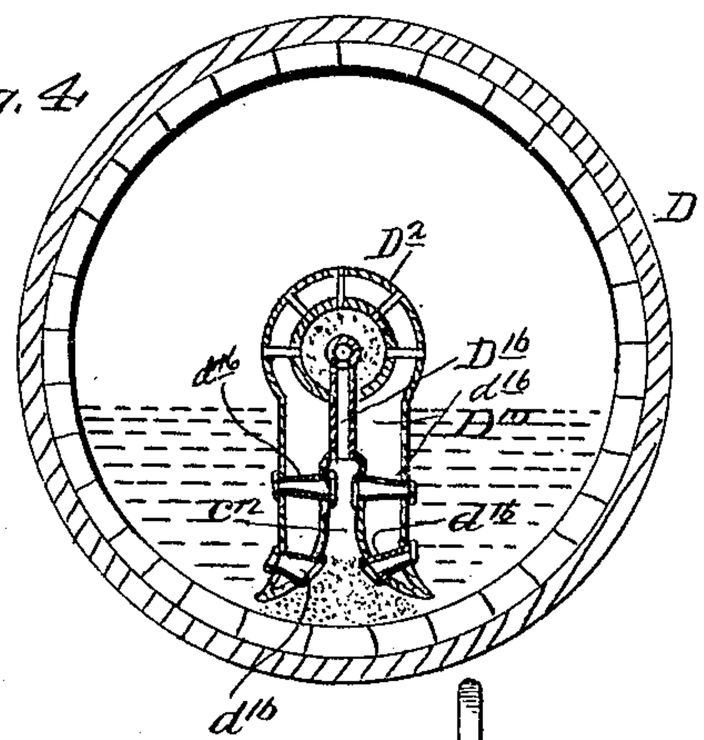
3 SHEETS—SHEET 2.

Fig. 4



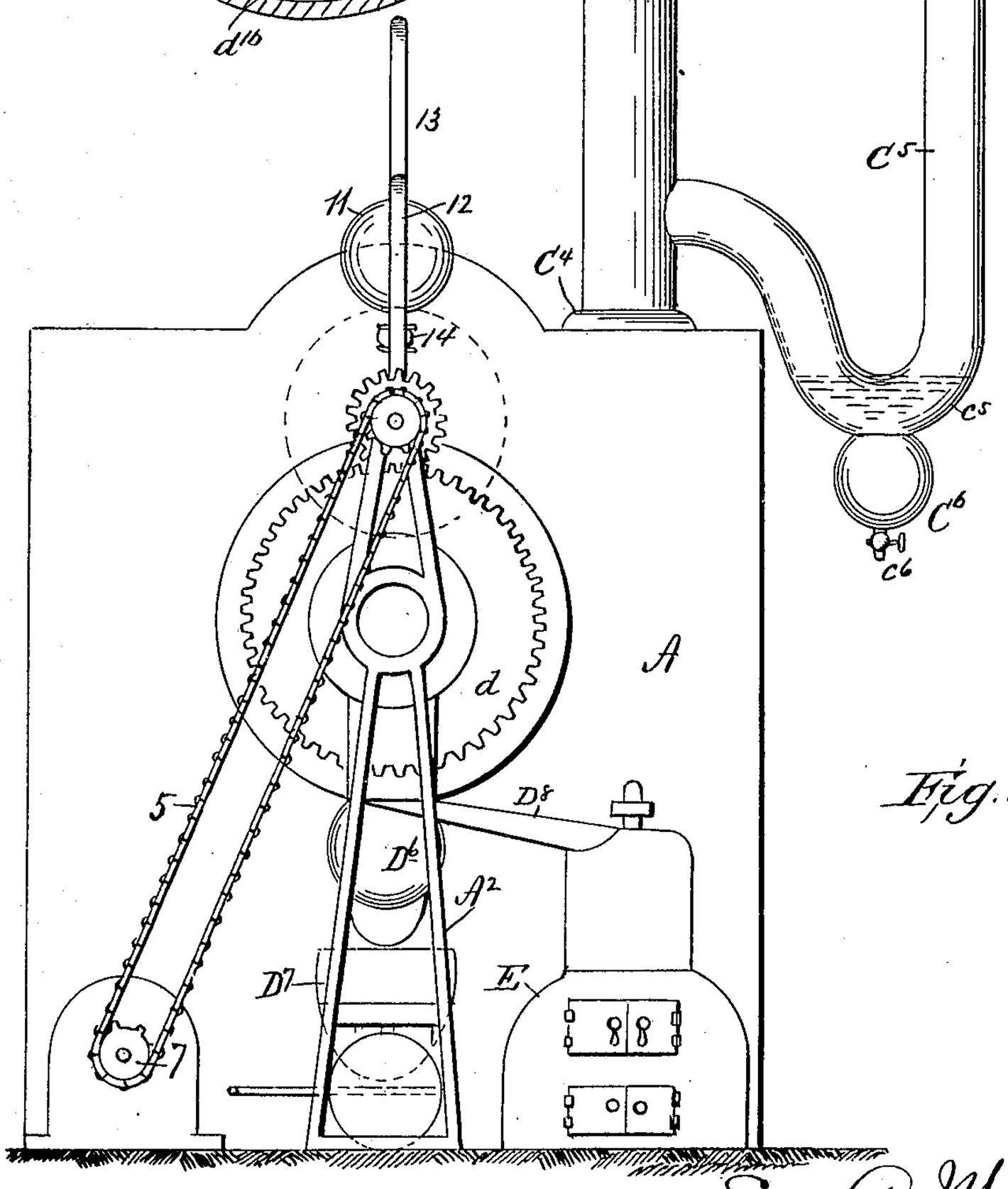


Fig. 2.

Witnesses

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3 SHEETS—SHEET 3.

Fig. 3.

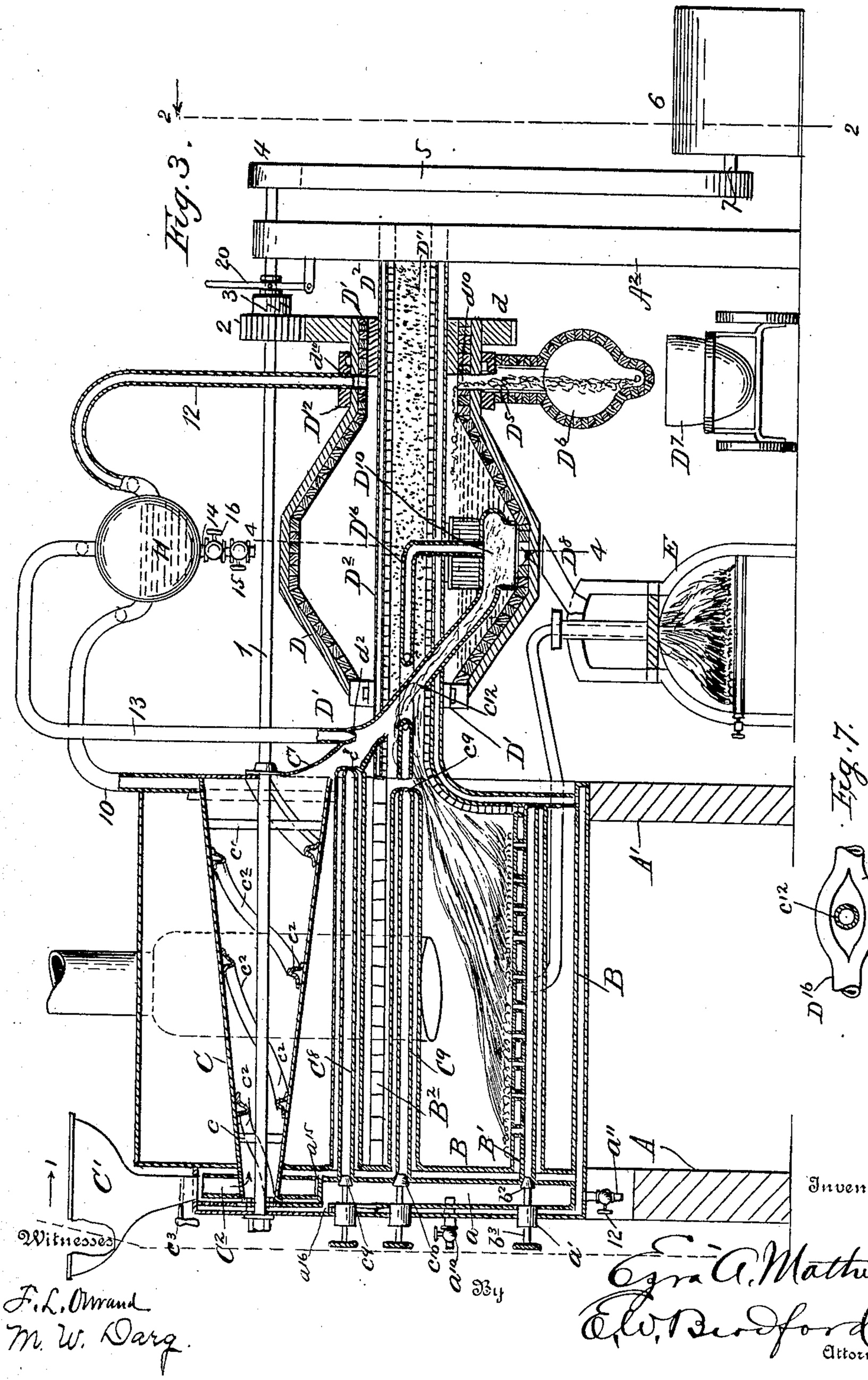

Fig. 7.

UNITED STATES PATENT OFFICE.

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ORE-SMELTER.

No. 916,176. Specification of Letters Patent. Patented March 23, 1909.

Application filed July 3, 1906. Serial No. 324,706.

To all whom it may concern:

Be it known that I, EZRA A. MATHERS, a citizen of the United States, residing at Philadelphia, in the county of Philadelphia and State of Pennsylvania, have invented certain new and useful Improvements in Ore-Smelters, of which the following is a specification.

My said invention consists in an improved construction of an apparatus for smelting and separating ores, whereby such an apparatus is provided wherein the operation of roasting and smelting is continuous and the consequent advantages secured, all as will be hereinafter more fully described and claimed.

Referring to the accompanying drawings which are made a part hereof and on which similar reference characters indicate similar parts, Figure 1 is an end elevation of a smelting apparatus of my improved construction and arrangement as seen when looking in the direction indicated by the arrows from the dotted line 1—1 on Fig. 3, Fig. 2 an elevation of the other end of said apparatus as seen in looking in the direction indicated by the arrows from the dotted line 2—2 in Fig. 3, Fig. 3 a longitudinal vertical section through the same, Fig. 4 a detailed cross-section on the dotted line 4—4 in Fig. 3, and Figs. 5, 6 and 7 detail views showing parts in section and on an enlarged scale.

In said drawings the portions marked A, A′ and A^2 represent the supporting frame of the apparatus, B the combustion chamber, C the roaster and D the smelter.

The supports A, A′ and A^2 are of suitable construction and arrangement to support and afford bearings for the different parts of the apparatus.

The combustion chamber B is constructed upon the supports A and A′ and comprises a hollow grate B′ situated a short distance above the floor of said chamber and a top or arch B^2 composed of fire-brick or other suitable heat resisting material. Suitable doors b and b' are provided in the end of the chamber through which the fuel may be supplied. The outer end of the chamber is formed of two double walls as shown most clearly in Fig. 3, a compressed air chamber a being formed between them, which extends from the bottom of the casing to a point closed by a top a^{15}. The compressed air is supplied to said chamber from any source through a pipe a^{10}. The walls and bottom of said chamber B are formed double, as shown, with a water jacket space between, which is supplied with water through a pipe a^{11} leading from any convenient supply, provided with a valve a^{12} by which said supply is controlled. The top of said water jacket-space is closed in the end structure by the top a^{15} across the inner wall and the top partition a^{16} across the space in the outer wall. A valve b^2 mounted on a valve stem b^3 is mounted in a screw-threaded perforation in a block a' set in the outer wall of the chamber and adapted to seat in a perforation in the inner wall of the air chamber a, which communicates with a space under the grate B′ and is thus adapted to provide a forced draft and regulate the supply of air to the combustion chamber.

The roaster C C comprises a cone-shaped casing mounted to rotate upon a shaft 1 which extends the entire length of the machine and is mounted in bearings in the top of the support A^2 and both ends of the casing surrounding the combustion chamber and roaster. Said roaster is supported on said shaft by means of spiders c c' and has internal hollow spiral conveyer flights c^2 of the form best shown in cross section in Fig. 6. Said flights are perforated on their front sides and communicate at the small end of the roaster by means of perforations c^{10} with the compressed air supply, which passes from under the top a^{15} of chamber a over the partition a^{16} into the outer hollow wall of the casing and passes through said perforations c^{10} to within said hollow conveyer flights. A hopper C′ is mounted upon the small end of the roaster provided with a slide valve c^3 in its lower end, by means of which its contents may be discharged into the wheel C^2 mounted upon the small end of the roaster C immediately beneath the discharge spout of said hopper. Said wheel comprises two disks with radial partitions c^{11} set at regular distances apart, forming pockets which receive the crushed ore from said hopper and deposit it through openings in the bottom of said pockets into the interior of said roaster C. Said roaster is kept at a high temperature by the furnace beneath and the crushed ore thus fed into the small end thereof is continuously agitated and kept in motion toward the large end by the rotary motion of the chamber and the spiral conveyer flights therein. The jets of compressed air coming through the perforations in the front

sides of said flights serve to accelerate the motion of the lighter particles and prevent them from adhering to the sides of the chamber. At the large end the ore remaining is in a thoroughly roasted condition and is discharged into spout C^7 and through the passage-way c^{12} into the melting box D^{10} of the smelter D. Those elements in the ore that are convertible into gas at the temperature of the roaster pass out of the top of the chamber intermittently, as the opening in the large end thereof comes around in each revolution thereof to register with the lower end of pipe 10, through said pipe into a reservoir 11, where they pass through a water bath contained in said reservoir and pass out through pipe 13, as will be presently described. A compressed air pipe C^8 leads from the compressed air chamber *a* above the arch B^2 of the combustion chamber and is provided with a discharge nozzle c^8 projecting into the side of spout C^7, the blast of air coming through said pipe serves to accelerate the discharge of the roasted ore through said spout, the passage way c^{12} and into the smelter. Said pipe C^8 is surrounded by a water jacket connected with the water jacket of the inner wall of the casting, as shown. A similar air pipe C^9 is arranged within the upper portion of the combustion chamber, beneath the arch B^2, and is provided with a discharge nozzle c^9 at the entrance of the passage from said combustion chamber to the passage c^{12} into the smelter. The air blast from this pipe serves to drive the heat from the top of said combustion chamber into said smelter. This pipe is also provided with a water jacket communicating with the water jacket in the inner wall of the casing, as shown.

A smoke stack C^4 leads from the top of the combustion chamber B through the top of the casing at one side of the roaster C. Its upper end is closed with a cap c^4 and a branch pipe C^5, formed with a trap portion c^5 containing water, leads from one side of said smoke stack C^4. A catch-basin C^6 is mounted on the lower side of the trap c^5 and contains a discharge nozzle c^6 through which the sediment may be discharged. The products of combustion are thus thoroughly washed and all solid matter separated from the gases before they are allowed to escape.

The smelting chamber D is a barrel-like structure of large diameter in the center and tapered from said center toward each end, which ends are secured in collars D′ mounted to revolve upon a hollow cylinder D^2, which is supported in suitable supports provided on the parts A′ and A^2 of the supporting frame. Said cylinder D^2 is formed double with a water jacket space between its two walls which communicates with the water jacket space in the bottom of the combustion chamber B. Its end adjacent to the combustion chamber opens into and communicates with the top of said combustion chamber. The passage way c^{12} leads through said cylinder at an angle, the top of said passage way being outside the rotary smelting chamber D and its lower end passed through the lower side of said cylinder D^2 at a point within said chamber, the side of said passage between the top and bottom sides of the cylinder being open to allow the heat from said combustion chamber to be driven by the compressed air from the pipe C^9, through said passage way c^{12} into a smelting box D^{10}, formed by hollow walls mounted upon and to hang downwardly from the cylinder D^2 and being rigid on said cylinder. The construction and form of this smelting box is shown in Figs. 3 and 4, particularly in Fig. 4, where its walls are shown to be hollow and connected with the water jacket around cylinder D^2. Said walls are braced by hollow struts d^{16} which are open at their ends and form passage ways through the sides of said walls. Another pipe D^{16} preferably runs through the center of cylinder D^2 from a point adjacent to the nozzle c^9, around pipe c^{12}, as shown in Fig. 7, and then down into the top of box D^{10}. The inner wall of cylinder D^2 is lined with fire-brick and from the inner wall of passage way c^{12} to its opposite end is filled with fire clay or other suitable heat resisting material D^{11}. A collar D^{12} surrounds the outer end of the rotary chamber beneath said collars at regular distances apart. A receptacle D^6 for the slag is mounted on the lower side of collar D^{12} being connected by a passage way D^5 with an opening in said collar which is adapted to intermittently register with the openings through the side of the chamber D as said chamber rotates. A pipe 12 leads from an opening in the upper side of said collar d^{12} to the reservoir 11 above the apparatus. The gases pass from the upper part of the smelting chamber through said pipe 12 into said reservoir, through the bath contained therein and then through pipe 13, which leads from the top of said separator 11 back to the passage way c^{12} where the gases add to the combustion and heat within the smelter while the solid matter may be drawn off through pipe 14. A gear wheel *d* is mounted on one end of the rotary chamber B and is adapted to mesh with a gear wheel 2 on shaft 1. Said gear wheel 2 is connected to said shaft 1 by means of a clutch 3 adapted to be operated by a shifting fork 20 in the usual manner. A belt pulley 4 on the outer end of said shaft 1 is connected by a belt 5 with the driving shaft 7 of a motor 6 by which driving power is supplied to the parts.

In operation, the pulverized ore is deposited in hopper C′, the valve c^3 is opened, the shaft 1 and connected apparatus started in motion, when the ore drops into the pock-

ets in the wheel C^2 and is fed into the roaster C where the rotary motion and spiral conveyers operate to convey it toward the large end as before described. The roasted ore is forced through passage c^{12} into smelting box D^{10} and is here melted. The pulverized ore comes into said box as best indicated in Fig. 4, dropping upon the inner wall of the chamber D, between the walls of said box accompanied by the heat and fire from the furnace driven by the blast from compressed air pipe C^9, not only through the passage c^{12} but also through pipe D^{16}. The air pressure operates to keep the circulation through the hollow struts d^{16} out through the molten material contained in the chamber on each side of said box. Said chamber being in motion the material is carried along on the rotating wall from under the point of the wall of said box and through the molten ore where such particles as may not yet be melted are reduced to a molten state. The gases arising in the top of the chamber D are allowed to pass upwardly through the pipe 12 into the separator 11 where they are washed and said gases may then pass through the pipe 13 back to the passage c^{12} while the sediment may be discharged through a discharge pipe 14 controlled by valves 15 and 16. The blast coming through pipe C^9 and the passage way into the smelter operates to blow the slag which arises on the top of the melted ore to the opposite end of the chamber where it passes through an opening into the discharge channel D^5 and then into a receptacle D^6 from which it may be discharged into any suitable receptacle D^7 arranged to receive it. The melted ore is drawn off through the pipe D^8 into an ore separator E of any suitable or approved construction, the operation of which is well understood in the art.

Having thus fully described my said invention, what I claim as new and desire to secure by Letters Patent, is:—

1. A smelting apparatus comprising a roaster arranged to discharge into a rotary smelter, said rotary smelter containing a stationary part adjacent to one side thereof, and means for supplying heat to both said roaster and smelter, substantially as set forth.

2. A smelting apparatus comprising a heating furnace, a rotary roaster directly above said furnace, a rotary smelter alongside said furnace, said roaster and furnace being both arranged to discharge their products into said smelter, substantially as set forth.

3. A smelter comprising a furnace, a rotary roaster mounted therein, a rotary smelter alongside said furnace, and a stationary part in said rotary smelter, the roaster and furnace being arranged to discharge their products into said smelter adjacent to said stationary part, substantially as set forth.

4. A smelter comprising a furnace, a rotary roaster directly above and in the same casing with said furnace, a smelter arranged adjacent to the casing containing said furnace and roaster and in a single structure therewith, said structure being formed with an ore-conduit leading from said roaster into said smelter, said several parts being arranged to coöperate continuously, substantially as set forth.

5. In a smelting apparatus, the combination, of the furnace, the smelter, and a rotary roaster mounted in said furnace and formed cone-shaped and arranged with its small end to receive the ore and its large end to discharge said ore into a conduit leading into said smelter and formed with conveyer flights on its interior, substantially as set forth.

6. In a smelting apparatus, the combination, of the furnace, the roaster comprising a rotary cone-shaped chamber mounted in the top of said furnace and formed with spiral conveyer flights on its interior, a hopper arranged to discharge into the small end of said roaster, a discharge spout leading from the large end to the passage to the smelting chamber, and said smelting chamber arranged alongside said furnace, substantially as set forth.

7. In a smelting apparatus, the combination, of the furnace, the roaster comprising a rotary chamber arranged to receive the ore at the small end and dscharge it at the large end, a feed hopper above said small end, a wheel containing pockets mounted upon said small end and communicating with the interior of said roasters, conveyers in said roaster, means for discharging the ore from said roaster into the smelting chamber, and said smelting chamber, substantially as set forth.

8. In a smelting apparatus, the combination, of the casing, the furnace, the roaster, the smelting chamber, an air chamber in said casing, means for supplying air under pressure thereto, and blast pipes leading from said air chamber to the several points in the apparatus where air blasts are needed, substantially as set forth.

9. In a smelting apparatus, the combination, of the casing, an air chamber therein, means for supplying air under pressure to said chamber, the furnace, the roaster, hollow spiral perforated conveyer flights in said roaster, a communication being formed from said air chamber to the interior of said flights, and the smelting chamber, substantially as set forth.

10. In a smelting apparatus, the combination, of the casing, the furnace, the roaster, the smelting chamber mounted to rotate, means for discharging the ore from the roaster direct to the smelting chamber, means for directing the heat from the furnace

to the smelting chamber, means for discharging the slag and means for withdrawing the melted ore, substantially as set forth.

11. In a smelting apparatus, the combination, of the furnace, the roaster, in the same casing with said furnace, the smelting chamber alongside said furnace, a conduit leading from said roaster and said furnace into the same end of said smelting chamber, means for carrying off the gases, and means for discharging the melted ore, substantially as set forth.

12. In a smelting apparatus, the combination, of the furnace, the roaster, a gas receiving and washing reservoir, a pipe leading from said roaster to said reservoir, the smelting chamber, a pipe leading from said smelting chamber to said reservoir, and a pipe leading from said reservoir to discharge into said smelter, substantially as set forth.

13. In a smelting apparatus, the combination of the furnace, the roaster, and the smelting chamber, said smelting chamber being mounted to rotate, a stationary smelting box within said chamber its underside being open adjacent to the wall of the rotary chamber, and pipes leading from said roaster and furnace into said smelting box, substantially as set forth.

14. In a smelting apparatus, the combination of the furnace, the roaster, the rotary smelting chamber and a stationary smelting box within said smelting chamber, arranged to receive the ore and heat and communicating with the rotary chamber, substantially as set forth.

15. In a smelting apparatus, the combination of the furnace, the roaster, the smelting chamber mounted adjacent to said roaster and furnace and arranged to rotate, a smelting box within said rotary chamber arranged to receive the pulverized ore and heat from the furnace and roaster and communicating with said rotary chamber, substantially as set forth.

In witness whereof, I have hereunto set my hand and seal at Washington, D. C., this 14th day of June, A. D. nineteen hundred and six.

EZRA A. MATHERS. [L. S.]

Witnesses:
E. W. BRADFORD,
CHAS. E. RIORDON.