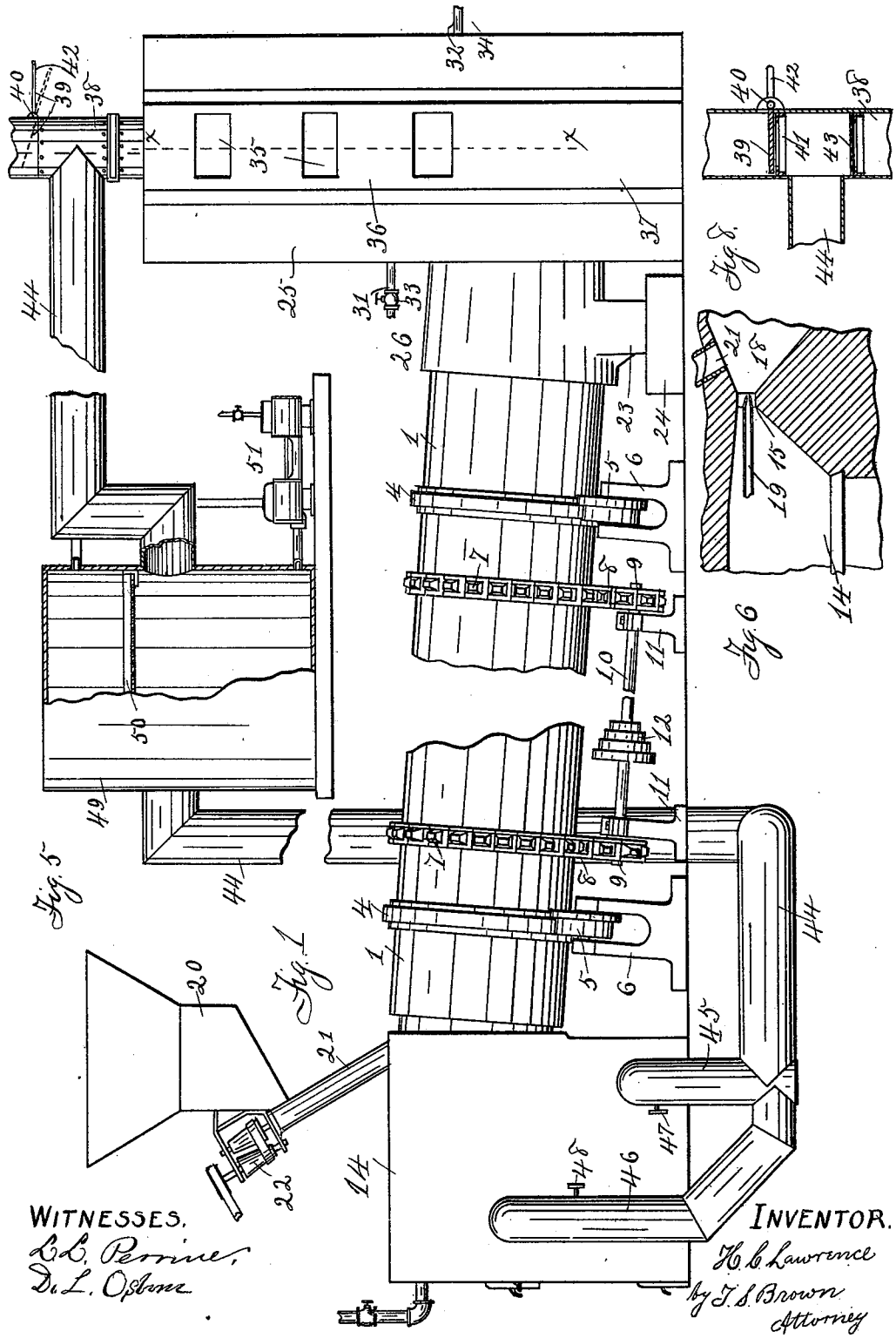
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APPARATUS FOR OXIDIZING ORE.

(Application filed Mar. 17, 1900.)

(No Model.) 2 Sheets—Sheet 1.



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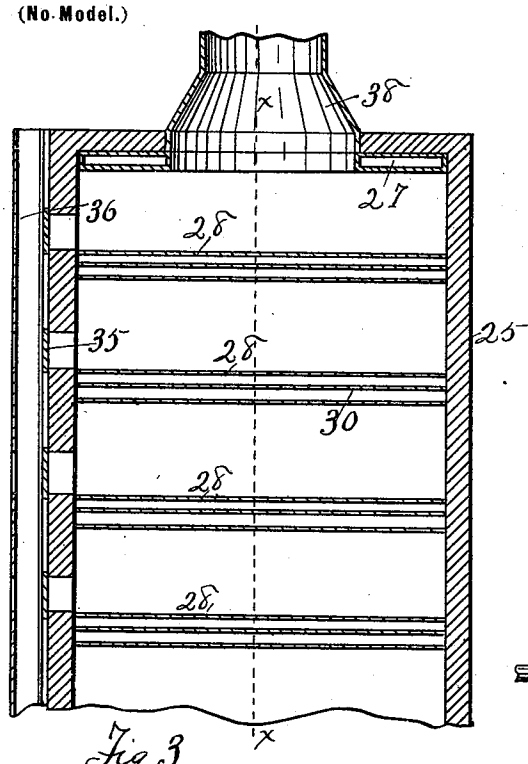


Fig. 3.

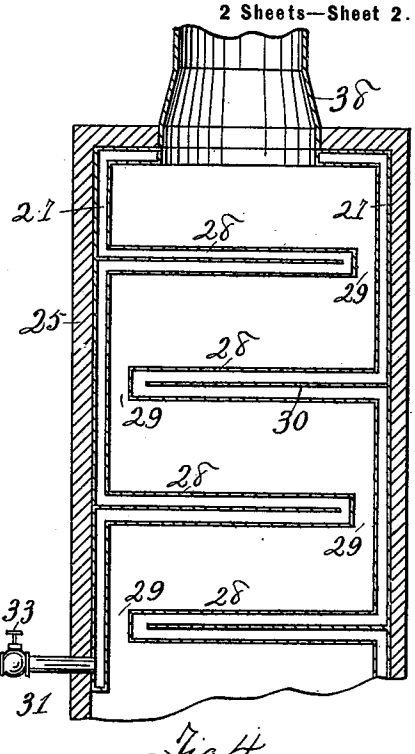


Fig. 4.

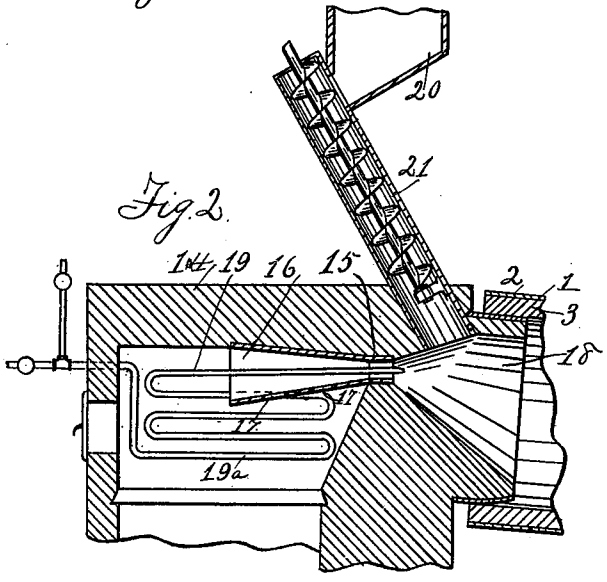


Fig. 2.

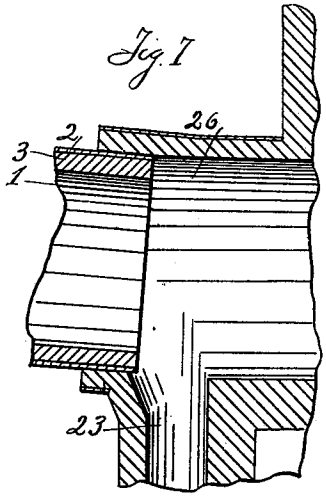


Fig. 1.

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APPARATUS FOR OXIDIZING ORE.

SPECIFICATION forming part of Letters Patent No. 672,065, dated April 16, 1901.

Application filed March 17, 1900. Serial No. 9,129. (No model.)

To all whom it may concern:

Be it known that I, HENRY C. LAWRENCE, a citizen of the United States, residing at Denver, in the county of Arapahoe, in the State of Colorado, have invented certain new and useful Improvements in Ore-Oxidizing Apparatus, of which the following is a full, clear, and exact description, reference being had to the accompanying drawings, which form a part of this specification.

My invention relates to apparatus for reducing mineral ores by oxidation and taking care of the mineral and by-products carried over with the combustion and oxidizing vapors and gases; and my invention consists in certain features of novelty hereinafter described, and pointed out in the claims.

Figure 1 represents a side elevation of my improved apparatus. Fig. 2 represents a longitudinal section showing the throat of the furnace and its connection with the oxidizing-drum. Fig. 3 represents a vertical section of the separating-chamber for separating the mineral and by-products of oxidation that may be carried over from the vapors, taken on the line X X of Fig. 1. Fig. 4 represents a vertical section on the line X X of Fig. 3. Fig. 5 represents, in partial cross-section, the tank for washing the vapors and gases in passage from the separating-chamber back to the furnace. Fig. 6 represents a detail cross-section of the throat of the furnace with the casing omitted. Fig. 7 represents a cross-section showing the communication between the oxidizing-drum and the precipitating-chamber. Fig. 8 represents a cross-section of the discharge-pipe, showing the damper and screen therein.

Similar numerals refer to similar parts throughout the several views.

1 represents an oxidizing-drum formed with an outer metallic casing 2 and a lining of fire-brick or like refractory material 3. Said drum is provided with the circumferential tracks 4, arranged to travel on the flanged wheels 5, mounted upon the standards 6, the mounting being such that the feed end of the drum is slightly higher than the discharge end, thus providing for the travel of the material through the drum.

7 represents a series of sprocket-teeth mounted upon the drum, a sprocket-chain 8, engaging said teeth, and a sprocket-wheel 9 on a shaft 10, mounted on the standards 11. A cone-pulley 12 is mounted on said shaft 10, belted to any convenient source of power, and thereby a motion of revolution given to the drum, which may readily be accelerated or diminished by adjustment of the belt on the cone-pulleys.

14 represents a furnace having a restricted throat 15. In said throat is seated the smaller end of a cone-shaped casing 16, extending a distance forward into the furnace and provided with openings 17 in its lower side, the purpose of the said casing being to collect and concentrate the heat from the furnace at the discharge-opening of the throat 15. Said casing may, however, be omitted when solid fuel is used, the same being designed more particularly for use when liquid or gaseous fuel is employed. Said furnace communicates with the oxidizing-drum 1 through the conical passage 18, which expands toward the drum, the wall forming said passage entering a short distance and fitting closely within the drum, but not so as to interfere with the revolution of the drum.

19 represents a pipe passing through the furnace and through the casing 16 to the throat 15 and connected with a steam-boiler, (not shown,) or the steam may be generated in a coil of water-pipes 19^a, arranged in the furnace and connected with a source of water-supply and with the steam-pipe 19. The steam passing through said pipe is superheated and under pressure is discharged at a high velocity at the throat 15, and thus acts in the nature of an injector to generate a strong draft to the furnace and into the drum through the passage 18.

The ore is fed from the chute 20 through the screw conveyer 21, the screw forming a force feed and preventing clogging of the ore. Said screw is operated by the cone-pulleys 22, whereby the feed may be regulated as may be desired, and is thus automatic and continuous. The conveyer 21 discharges into the passage 18 from the furnace directly at its entrance into the drum, so that the ore immediately upon its discharge is subjected to the oxidizing action of the blast from the furnace

and continues subject thereto until the discharge at the opposite end of the drum of the unvolatilized oxidized product through the chute 23 into the ore-bin 24, from which it may be removed by means of the usual conveyer or otherwise, as may be desired. In practice it is found prudent that the chute 23 should extend somewhat below the line of the ore in the bin 24 to prevent the escape and dissemination of the vapors and fumes which might otherwise pass down through the chute.

25 represents a separating or precipitating chamber communicating with the oxidizing-drum through the passage 26, the drum extending into said passage such distance and fitting sufficiently close as to prevent the escape of the vapors and fumes without interfering with the action of the drum. Said precipitating-chamber is provided on its sides with the water-jackets 27 and on its interior with a series of hollow shelves 28, communicating alternately with the water-jackets on the opposite sides and providing alternately on opposite sides the passages 29 for the passage of the vapors and volatilized oxids through the chamber. To provide for the circulation of the water from the water-jackets through said shelves 28, as well as through the water-jackets, medial plates 30 are mounted therein, the water being admitted through the pipe 31 and discharged through the pipe 32, said pipes being provided with the stop-cocks 33 and 34. By the circulation of the water the shelves are cooled and the vapors in passage coming in contact therewith are cooled, so that the volatilized oxids and other mineral products carried over are precipitated upon the shelves, whence they may be removed by drawing out through the doors 35, whence they will fall through the chute 36 into an ore-bin 37. A discharge-pipe 38 from said separating-chamber leads to the smoke-stack or outer atmosphere. Said pipe is provided with a damper 39, hinged at one side to the pipe, as shown at 40, and arranged to close upon and to be supported by an annular flange or bracket 41, secured upon the pipe. Said damper may be provided with a handle 42, by which the same may be operated, if desired. A screen 43, of fine wire-gauze, is also provided in said pipe to obstruct the passage of any solid matter that may not have been precipitated in the circuitous passage through the chamber. Said screen may, if desired, be constructed of gunny-cloth or like material, the vapors and other matter having been cooled off by contact with the cooling-shelves to such extent as to prevent any danger of setting fire to the screen.

44 represents a return-pipe communicating with said discharge-pipe 38 between said damper and said screen and leading back to the furnace and discharging therein through the pipe 45 under the grate-bars, so that the returned gases shall pass up through the fuel or through the pipe 46 over the fuel, said pipes being provided with dampers 47 and 48, so that either one or both thereof may be used, as desired. In said return-pipe 44 is interposed a tank 49, containing water and provided with a perforated intermediate bottom 50 immediately above the line of the inlet and outlet of said pipe. A pump 51 is provided for pumping the water from the lower to the upper part of the tank, which is thence sprayed through said perforated bottom, and thereby the sulfuric acid formed in the oxidizing process and carried over with the gases is washed out as the gases pass through the tank.

The weight of the damper 39 is such that under ordinary pressure in the drum and precipitating-chamber the gases will pass through the return-pipe 44; but if from any cause there should be excessive pressure said damper will be raised, and acting as a safety-valve such excessive pressure will be relieved and any danger therefrom is thus avoided.

In ordinary treatment the length of the drum and the inclination and rapidity of rotation are such that the ore from its entrance into the drum until its discharge therefrom is subjected to the oxidizing action for about two hours; but this may of course be varied by a different inclination of the drum or by a more or less rapid rotation, as may be desired, or as may be required from the nature of the ore to be treated.

Among the more important advantages gained by the use of this apparatus may be noted:

First. The operation is continuous, it not being necessary to stop to remove the contents of the drum and recharge the same.

Second. By the injector action of the steam-jet, arranged in the narrow throat of the furnace, the heat of combustion of the combustion products generated in the furnace is not confined to and wasted in the furnace, but is carried directly into the drum and there utilized, the furnace acting merely as a generator to free the combustion products from the fuel.

Third. The widening of the passage between the furnace and the drum permits the expansion and sudden inflammation of the gases, and the ore being fed at this point is subject, immediately as it enters, to the intense heat generated and the oxidizing influence thereof.

Fourth. The ore as it travels through the drum is subjected to a constantly-increasing temperature and consequent greater oxidizing action.

Fifth. The volatilized oxidized products and other valuable by-products passing over with the vapor and fumes from the drum and which would otherwise be wasted are recovered by contact with the cooling-shelves in the precipitating-chamber.

Sixth. The sudden cooling by contact with the cooling-shelves prevents recombination

of the gases, so that very little, if any, non-combustible gases are formed and returned to the furnace.

Seventh. The sulfuric acid recovered as a by-product is in the treatment of ores containing sulfur more than sufficient to pay the running expenses of the apparatus.

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

1. In an ore-oxidizing apparatus the combination with a furnace, a rotating ore-drum, a passage communicating between said furnace and said drum, and a feed-chute communicating with said passage, of a conical casing arranged in the furnace and having its smaller end seated in said passage, and a steam-pipe extending into and terminating in said casing, whereby an injector-blast is delivered upon the ore as it is fed into said passage; substantially as set forth.

2. In an ore-oxidizing apparatus the combination with a furnace, a rotating ore-drum, and a passage communicating between said furnace and said drum, of a conical casing arranged in the furnace and having its smaller end seated in said passage, and a steam-pipe mounted in and arranged to be heated by the furnace, extending into and terminating near the end of said casing, whereby an injector-blast is provided from said furnace into said drum; substantially as set forth.

3. In an ore-oxidizing apparatus the combination with a furnace, and a rotating ore-drum communicating with said furnace through a suitable passage, of a conical casing arranged in the furnace and having its smaller end seated in said passage, and a steam-pipe extending into said casing whereby is formed an injector-blast from said furnace into said drum; substantially as set forth.

4. In an ore-oxidizing apparatus, a precipitating-chamber, hollow shelves, provided with interior circulating-plates, mounted in said chamber, and arranged to provide a circuitous passage for the vapors and gases through said chamber, and inlet and oulet passages communicating with said hollow shelves for providing circulation through the same; substantially as set forth.

5. In an ore-oxidizing apparatus a water-jacketed precipitating-chamber, hollow shelves mounted in said chamber communicating with the water-jacket thereof and arranged to provide a circuitous passage for the vapors and gases through said chamber, plates mounted in said hollow shelves and arranged to provide for the circulation of the water through the same, and valved inlet and outlet pipes, communicating with said water-jacket for controlling the circulation of the water through the said jacket and said shelves; substantially as set forth.

6. In an ore-oxidizing apparatus, a water-jacketed precipitating-chamber, hollow shelves provided with circulating-plates mounted in said chamber communicating with said water-jacket and arranged to provide a circuitous passage for the vapors and gases through said chamber, doors to said chamber for the removal of the precipitated products from said shelves, a chute mounted on the outer wall of said chamber for conveying the removed product to a suitable receptacle and valved pipes communicating with said water-jacket; substantially as set forth.

7. In an ore-oxidizing apparatus the combination with a rotating ore-drum, a furnace communicating with said drum, and a precipitating-chamber communicating with said drum, of a return-pipe communicating with said chamber and leading back to the furnace above the grate, and a pipe communicating with said return-pipe and with the furnace under the grate; substantially as set forth.

8. In an ore-oxidizing apparatus, the combination with a rotating ore-drum and a furnace communicating with said drum, of a precipitating-chamber communicating with said drum, a discharge-pipe for conveying the vapors and gases from said chamber, a damper hinged in said discharge-pipe, a bracket mounted in said discharge-pipe for supporting said damper when closed, and a return-pipe communicating with said discharge-pipe below said damper and with the furnace; substantially as set forth.

9. In an ore-oxidizing apparatus, the combination with a rotating ore-drum, a furnace communicating with said drum, and a precipitating-chamber communicating with said drum, of a return-pipe communicating with said chamber and with the furnace, a tank containing water interposed in the line of said return-pipe, and a perforated plate mounted in said tank above the line of the inlet and outlet of said pipe, whereby the water is sprayed over the returning vapors and gases for the removal of the soluble gases therefrom; substantially as set forth.

10. In an ore-oxidizing apparatus, the combination with a rotating ore-drum, of a furnace having a contracted throat, a conical casing having its smaller end seated in said contracted throat, and provided with openings on its lower side, and a steam-pipe entering said throat and forming therein an injector for conveying the combustion gases into said drum, and a passage communicating between said furnace and said drum, said passage being contracted at its inlet to correspond with said contracted throat of the furnace, and thence enlarging or expanding toward the drum; substantially as set forth.

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