No. 824,383. PATENTED JUNE 26, 1906.

J. D. RIVARD.

SMELTING FURNACE.

APPLICATION FILED DEC. 2, 1904.

Fig. 3

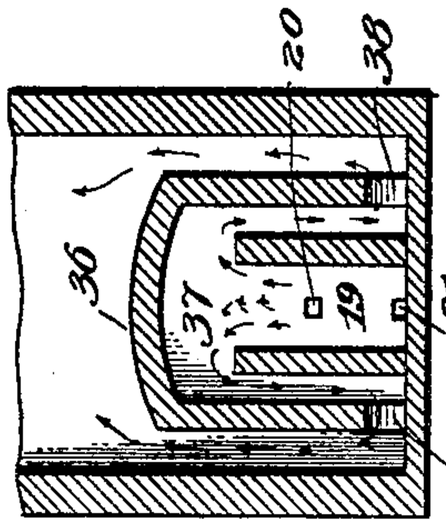


Fig. 4

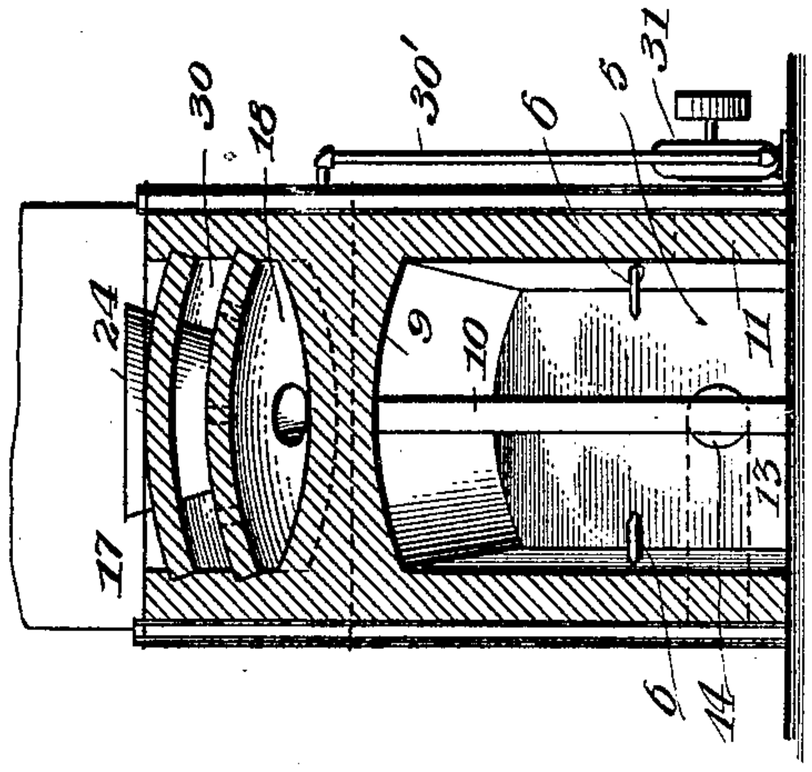


Fig. 1

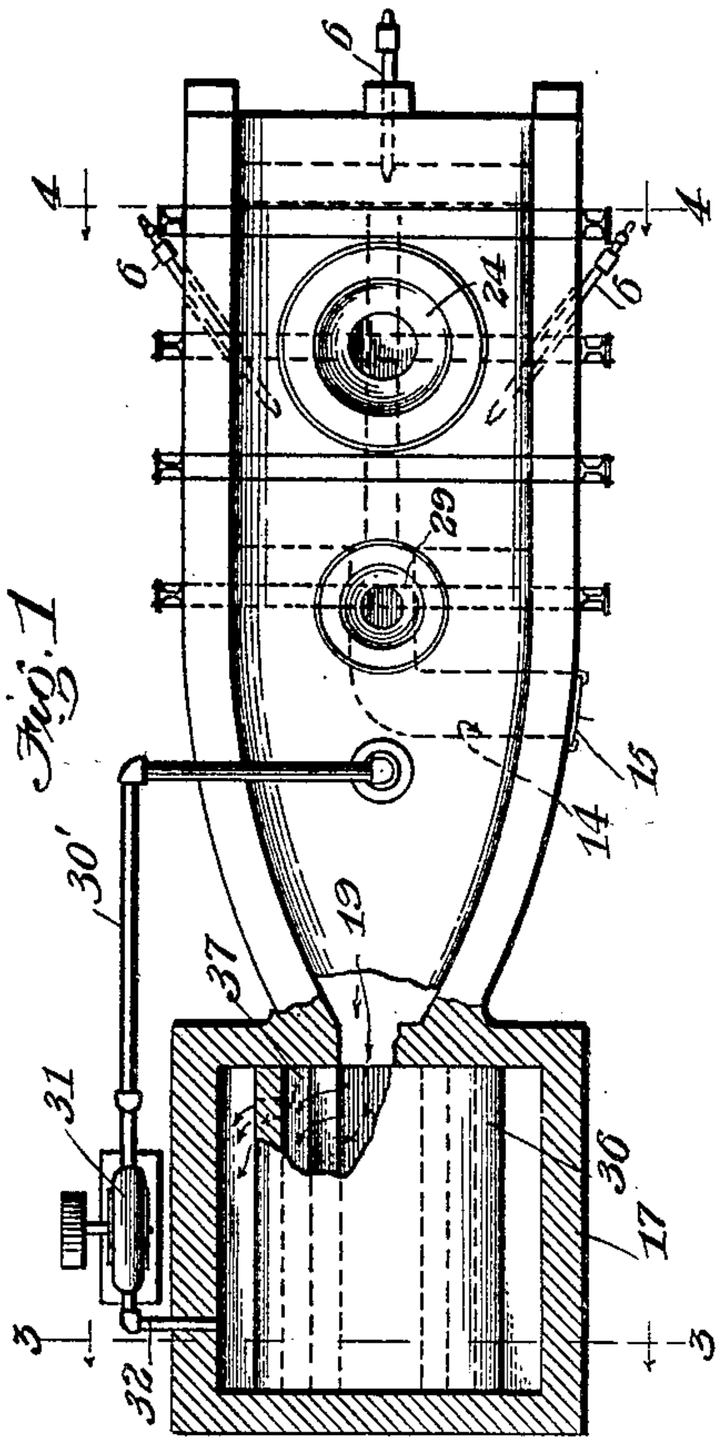
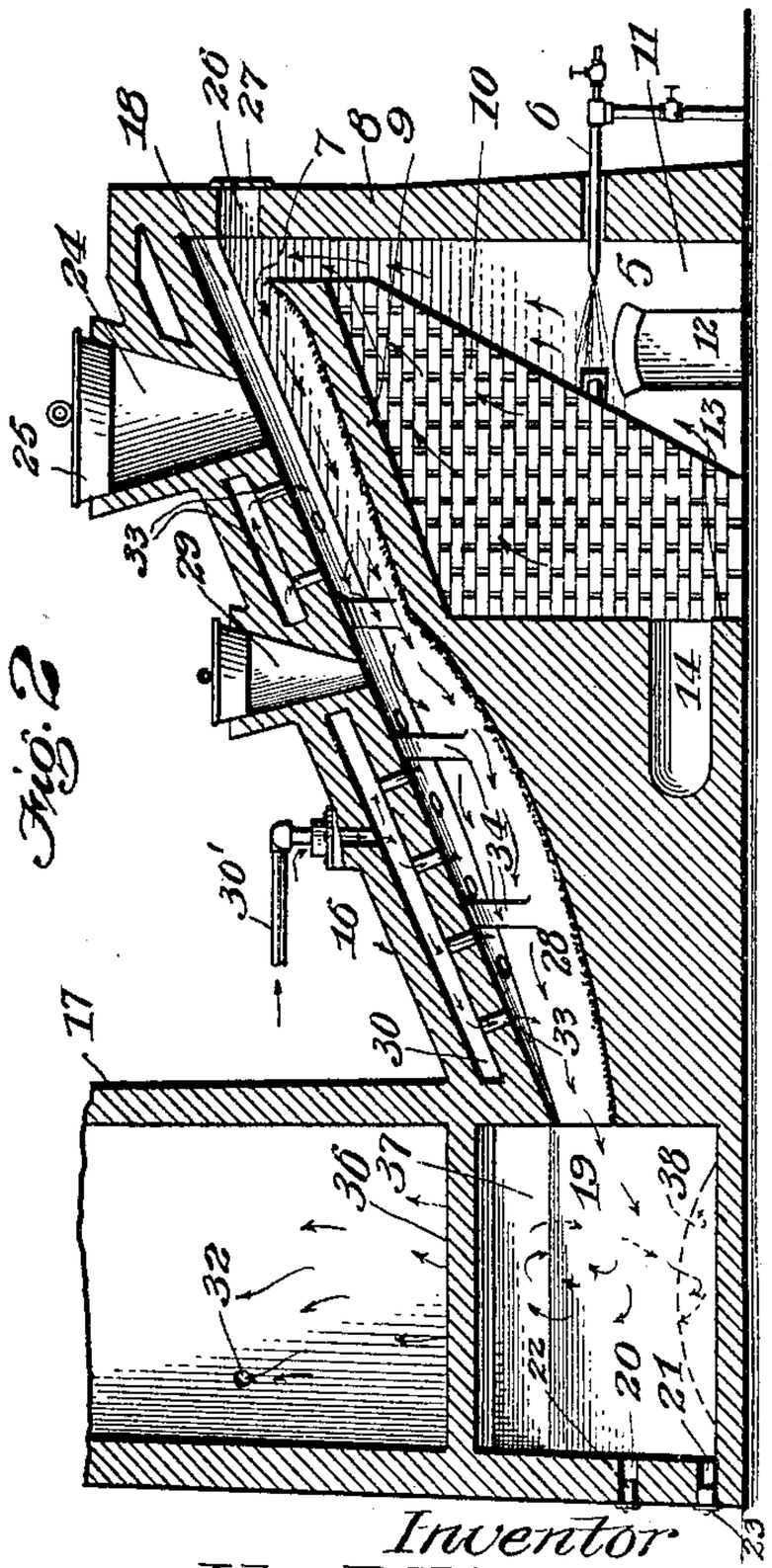


Fig. 2



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UNITED STATES PATENT OFFICE.

JOHN D. RIVARD, OF LOS ANGELES, CALIFORNIA.

SMELTING-FURNACE.

No. 824,383. Specification of Letters Patent. Patented June 26, 1906.

Application filed December 2, 1904. Serial No. 235,245.

To all whom it may concern:

Be it known that I, JOHN D. RIVARD, a citizen of the United States, residing at Los Angeles, in the county of Los Angeles, State of Cailfornia, have invented new and useful Improvements in Smelting-Furnaces, of which the following is a specification.

My invention relates to a smelting-furnace in which the heat is produced by means of hydrocarbon liquid fuel; and the object thereof is to produce a smelting-furnace which is continuous in operation and of simple construction and economical in operation; and a particular object is to produce a smelting-furnace in which iron ore may be smelted and produce a commercial article of pig-iron without further treatment. I accomplish this object by means of the furnace described herein, and illustrated in the accompanying drawings, in which—

Figure 1 is a plan view, partly in section. Fig. 2 is a longitudinal vertical section. Fig. 3 is a cross-section on the line 3 3 of Fig. 1. Fig. 4 is a cross-section on the line 4 4 of Fig. 1 looking toward the stack.

The walls, floors, or bottoms and other parts of my furnace may all be constructed of such material as is known to be practical for such purposes.

In the front end of the furnace—and by "front end" I mean the end opposite the stack—is the combustion-chamber 5, into which projects the liquid-hydrocarbon burners 6, of any desired make. Of these burners there may be any desired number; but I prefer to use three of such burners, one projecting through the front wall of the furnace and two through the side walls at an angle, as shown in Fig. 1. The throat 7 of the combustion-chamber is adjacent to the front wall 8, as best shown in Fig. 2, and opens into the higher end of the smelting-chamber. The roof 9 of the combustion-chamber is slightly arched, as shown in Fig. 4, and is on an upward slant toward the throat, as shown in Fig. 2. Extending vertically and centrally in the rear portion of the combustion-chamber is the baffle-wall 10, which is preferably formed of checker-work and may be made of fire-brick or other suitable material. The upper portion of this baffle-wall preferably extends to the throat, while the bottom portion only extends a short distance from the rear wall toward the front. The purpose of this wall is to enable me to use side burners in the combustion-chamber and to baffle the combustible gases and cause their impingement upon this wall and also upon the back wall and side walls of the combustion-chamber, which causes them to deposit on such walls a large portion of the objectionable carbon developed in the use of liquid-hydrocarbon fuel when used for smelting iron ore. In the side wall 11 of the combustion-chamber is a door 12, which provides means to remove this carbon from the combustion-chamber when desired. In the back wall 13 of the combustion-chamber is an L-shaped air-flue 14, the inlet of which is provided with a damper 15 to regulate the quantity of air that may be admitted therethrough into the combustion-chamber, as shown in Fig. 2 and by dotted lines in Fig. 1. The inner end of this air-flue opens on both sides of the baffle-walls, so that both sides thereof may be supplied with the necessary amount of air to produce the best combustion in the chamber. The top wall 16 of the furnace slants downwardly to its junction with the stack 17, and below the top wall is a downwardly-extending chamber 18 for the passage of the products of combustion therethrough and into the crucible 19, which is provided with an outlet 20, through which the slag may be drawn off, and with an opening 21 in the bottom thereof, through which the metal may be drawn off, said openings being closed in the usual manner by plugs 22 and 23. In the top wall of the furnace and opening into chamber 18 is feed-hopper 24, which receives the pulverized ore which is to be smelted. This hopper is preferably conical in shape, with the base at the top, as best shown in Fig. 2, and is provided with a removable cover 25. The conical shape of the feed-hopper permits the ore to pass therefrom and rest upon the top of the combustion-chamber in a cone-shaped mass, directly in the center of chamber 18, where it is subjected to the action of the products of combustion as they pass downwardly therethrough, space being left on each side of the ore, which subjects the ore to the necessary amount of heat to roast the same. At the same time the opening into the feed-hopper is closed by the ore that is contained therein, and before the ore is rabbled the feed-hopper can be filled with a fresh supply.

A rabble-hole 26 is provided in the front wall of the furnace, opening into the end of chamber 18, as shown in Fig. 2, to permit of the ore being rabbled. This opening is closed

by a door 27. Just at the rear of the combustion-chamber the chamber 18 is enlarged to form what I term a "smelting-chamber" 28. At the commencement of this smelting-chamber and opening thereinto is the carbon-monoxid feed-hopper 29, into which is fed any suitable material which will unite with the gases coming from the combustion-chamber to still further exhaust from said gases such carbon as has not been deposited in the combustion-chamber. Coal-dust, and pulverized coke I have found to be very suitable materials for that purpose. This carbon-monoxid feed-hopper is preferably conical in shape for the same reason as the feed-hopper, and the material which is deposited upon the bottom wall of chamber 19 can be rabbled when desired in the same manner as the ore and through the same door. In the top wall of chamber 18 is a chamber 30, which I term a "reheating-chamber." This chamber is connected by pipe 30′ with the blower 31, which blower is connected by pipe 32 with the stack. This reheating-chamber is provided with a plurality of outlets 33, which open into chamber 18. Along the sides of the chamber 18 are small baffle-walls 34, which slightly retard the passage of the products of combustion and, together with the action of the gas passing from the reheating-chamber, cause the produces of combustion to assume a wavy motion as they pass along. If desired, these side baffle-walls can be omitted; but I prefer their use on account of the assistance which they give in producing the wavy motion to the products of combustion as they pass through chamber 18, said motion being found desirable. The crucible is inclosed by the walls 36 of a directing-chamber 37 in the bottom of the stack. In the bottom of the side walls of the directing-chamber are ports 38, which open into the bottom of the stack.

In the operation of my furnace the feed-hopper is first filled with pulverized ore and the monoxid hopper is filled with suitable material to produce carbon monoxid. Liquid hydrocarbon fuel with the necessary steam or air to atomize the same, furnished from a supply not shown, is fed into the combustion-chamber and ignited. The damper of the air-flue is regulated to supply the combustion-chamber with the necessary amount of air. Power is applied to operate the blower. As soon as the ore which has lodged in chamber 18 has been properly roasted it is rabbled downwardly into the smelting-chamber, which by this time has been thoroughly heated and a new supply of ore is permitted to fall from the feed-hopper upon the bottom wall of chamber 18, which is likewise rabbled after it has been roasted. As the ore passes downwardly in chamber 18 the products of combustion are driven against the same by the action of the blower and before the ore reaches the bottom or outlet of the smelting-chamber it is in a thoroughly liquid state. It will also be seen that the products of combustion also pass downwardly into the crucible and then upwardly over the side walls thereof and then downwardly through the ports in the side walls of the directing-chamber where they escape into the stack, thereby keeping the crucible in a thoroughly-heated condition so that there is no possibility of the melted metal freezing in the same. As the products of combustion impinge upon the surface of the molten ore in the crucible, they have a tendency to better cause the separation of the metal from the slag. From time to time as required the feed-hopper and the carbon-monoxid hopper are replenished and the slag and metal drawn off, thereby rendering the operation of the furnace continuous.

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

1. In a smelting-furnace an inclined chamber; means to supply the products of combustion into the higher end thereof; means to feed ore into the higher end of said chamber; and means to supply blasts of downwardly-directed hot gas into said inclined chamber.

2. In a smelting-furnace an inclined chamber; means to supply products of combustion into the higher end thereof; means to feed ore into said higher end of said inclined chamber; means to feed a material to produce a carbon monoxid in said chamber below the ore-feed; and means to supply downwardly-directed hot blasts of gas in said inclined chamber.

3. In a smelting-furnace an inclined chamber; a stack at the bottom thereof into which said inclined chamber opens; means to feed ore into the top portion of said inclined chamber; means to supply heated blasts of gas directed toward the bottom of said inclined chamber; a combustion-chamber below the higher end of said inclined chamber and communicating with said higher end; and injector-burners in said combustion-chamber.

4. In a smelting-furnace; an inclined chamber; a combustion-chamber below the higher end of said inclined chamber and having the throat thereof opening into the higher end of said inclined chamber; means to supply ore into the higher end of said inclined chamber; a stack at the lower end of said inclined chamber; a crucible in the bottom of said stack; and means to supply downwardly-directed blasts of hot gas into said inclined chamber upon the ore passing therethrough.

5. In a smelting-furnace an inclined chamber; a combustion-chamber below the higher end of said chamber and having a throat thereof opening into the higher end of said chamber; means to supply ore into the higher end of said inclined chamber; a stack at the lower end of said inclined chamber; a cruci-

ble in the bottom of said stack; a covering for said crucible; means to supply material to produce a carbon monoxid between the ore-feed and the stack into said inclined chamber.

6. In a smelting-furnace an inclined chamber, a combustion-chamber below the higher end of said inclined chamber and having the throat thereof opening into the upper end of said inclined chamber; means to supply ore into the upper end of said inclined chamber; a stack at the lower end of said inclined chamber; a directing-chamber in the bottom of said stack, said directing-chamber having ports in the bottom of the side walls thereof opening into the stack; a crucible in said directing-chamber; a reheating-chamber in the top wall of said inclined chamber having a plurality of ports establishing communication between said chambers; a blower; a pipe connecting said reheating-chamber with said blower; and a pipe connecting said blower with said stack.

7. In a smelting-furnace an inclined chamber; a combustion-chamber below the higher end of said inclined chamber and having the throat thereof opening into the higher end of said inclined chamber; means to supply ore into the higher end of said inclined chamber; a stack at the lower end of said inclined chamber; a directing-chamber in the bottom of said stack, said directing-chamber having ports in the bottom of the side walls thereof opening into the stack; a crucible in said directing-chamber; a reheating-chamber in the top wall of said inclined chamber having a plurality of ports establishing communication between said chambers; a blower; a pipe connecting said reheating-chamber with said blower; a pipe connecting said blower with said stack; and means to supply material to produce a carbon monoxid into said inclined chamber between the ore-feed and stack.

8. In a smelting-furnace an inclined chamber; a combustion-chamber below the higher end of said inclined chamber and communicating therewith at the higher end of said inclined chamber; a centrally-disposed baffle-wall in the rear portion of said combustion-chamber; means to supply liquid hydrocarbon fuel into said combustion-chamber; a stack at the lower end of said inclined chamber; means to feed ore into the higher end of said inclined chamber; and a crucible within said stack into which said inclined chamber opens.

9. In a smelting-furnace an inclined chamber; a combustion-chamber below the higher end of said inclined chamber and communicating with said higher end; a centrally-disposed checker-work baffle-wall in the rear portion of said combustion-chamber; means to supply liquid hydrocarbon fuel into said combustion-chamber; means to supply air into the rear portion of said combustion-chamber on each side of said baffle-wall; a stack at the lower end of said inclined chamber; means to feed ore into the higher end of said inclined chamber; a directing-chamber in the bottom of said stack and having ports through the side walls thereof at the bottom opening into said stack; a crucible within said directing-chamber; and means to feed material to produce a carbon monoxid into said inclined chamber between the stack and the ore-feed.

10. In a smelting-furnace an inclined chamber; a combustion-chamber below the higher end of said inclined chamber and communicating with said higher end; a centrally-disposed checker-work baffle-wall in the rear portion of said combustion-chamber; means to supply liquid hydrocarbon fuel into said combustion-chamber; means to supply air into the rear portion of said combustion-chamber on each side of said baffle-wall; a stack at the lower end of said inclined chamber; means to feed ore into the higher end of said inclined chamber; means to feed material to produce carbon monoxid into said inclined chamber between the stack and the ore feed; means to supply a plurality of blasts of gas upon the ore passing through said inclined chamber; a directing-chamber in the bottom of said stack, said directing-chamber having ports in the bottom of the side walls thereof opening into the stack; and a crucible in said directing-chamber.

11. In a smelting-furnace an inclined chamber; a combustion-chamber below the higher end of said inclined chamber and communicating with said higher end of said inclined chamber; a centrally-disposed checker-work baffle-wall in the rear portion of said combustion-chamber; means to supply air into the rear portion of said combustion-chamber at each side of said baffle-wall; means to supply liquid hydrocarbon fuel into said combustion-chamber; means to feed ore into the higher end of said inclined chamber; means to feed a material to produce a carbon monoxid into said inclined chamber below the ore-feed; a reheating-chamber in the top wall of said inclined chamber and having a plurality of ports establishing communication between said chambers; a blower; a pipe connecting said blower with said reheating-chamber; a stack at the lower end of said inclined chamber; a directing-chamber in said stack, said chamber having ports in the bottom of side walls thereof opening into said stack; a pipe connecting said stack with said blower; and a crucible within said directing-chamber.

12. In a smelting-furnace an inclined chamber; a stack at the bottom thereof into which said inclined chamber opens; a crucible in the bottom of said stack; a directing-chamber extending over said crucible into which said inclined chamber opens, said directing-chamber having ports in the side walls thereof

near the bottom of the crucible, and there being a passage between the walls of the crucible and between the side walls of the stack whereby the products of combustion are compelled to pass downwardly at the sides of the crucible on their passage to the stack.

In witness that I claim the foregoing I have hereunto subscribed my name this 26th day of November, 1904.

JOHN D. RIVARD.

Witnesses:
G. E. HARPHAM,
EDMUND A. STRAUSE.