No. 748,561. PATENTED DEC. 29, 1903.

E. RIVEROLL.

SMELTING FURNACE.

APPLICATION FILED APR. 11, 1902.

NO MODEL. 2 SHEETS—SHEET 1.

Fig. IX.

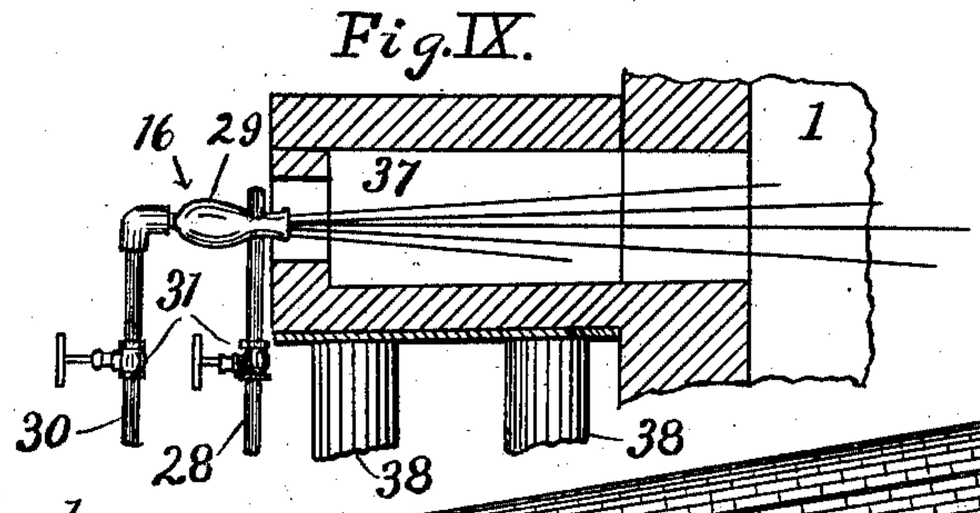


Fig. I.

Fig. III.

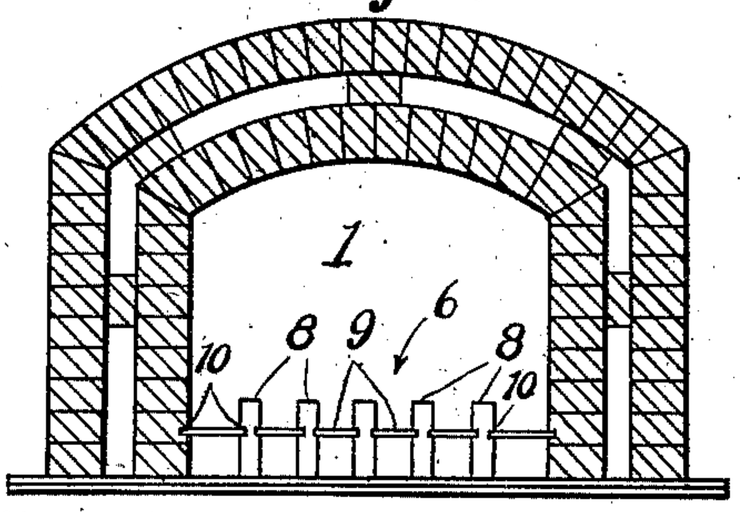
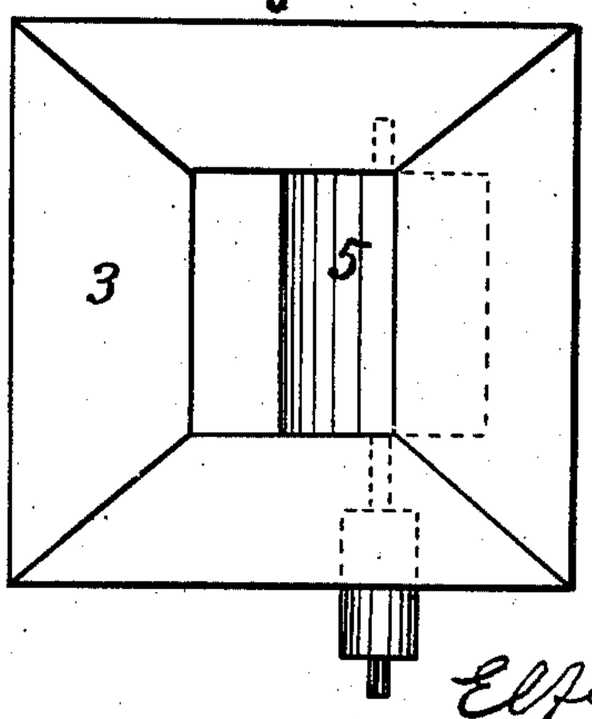


Fig. X.



Witnesses
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NO MODEL. 2 SHEETS—SHEET 2.

Fig. IV.

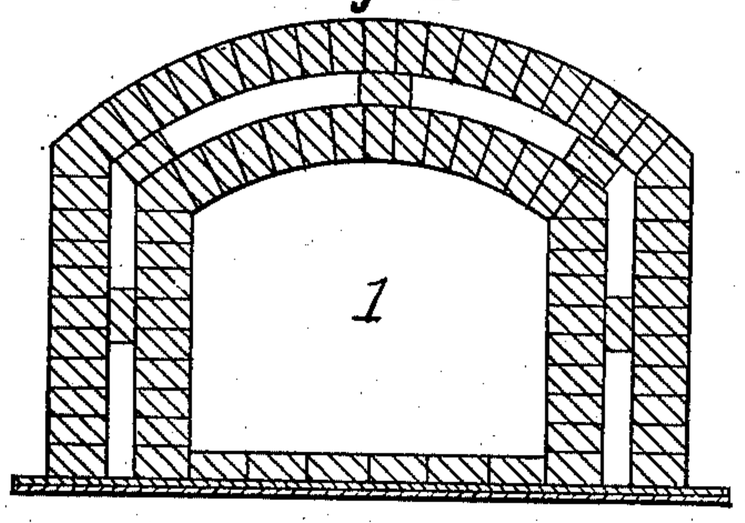

Fig. V.

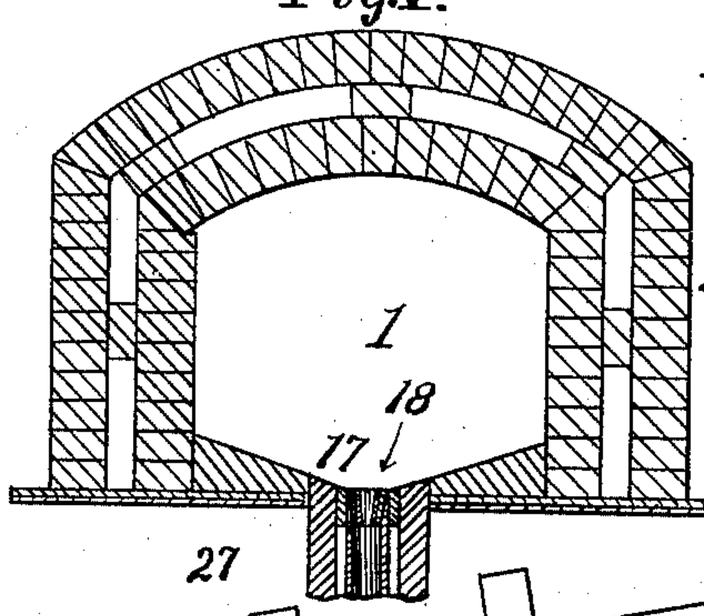

Fig. VIII.

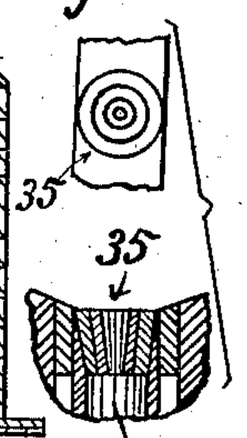

Fig. II.

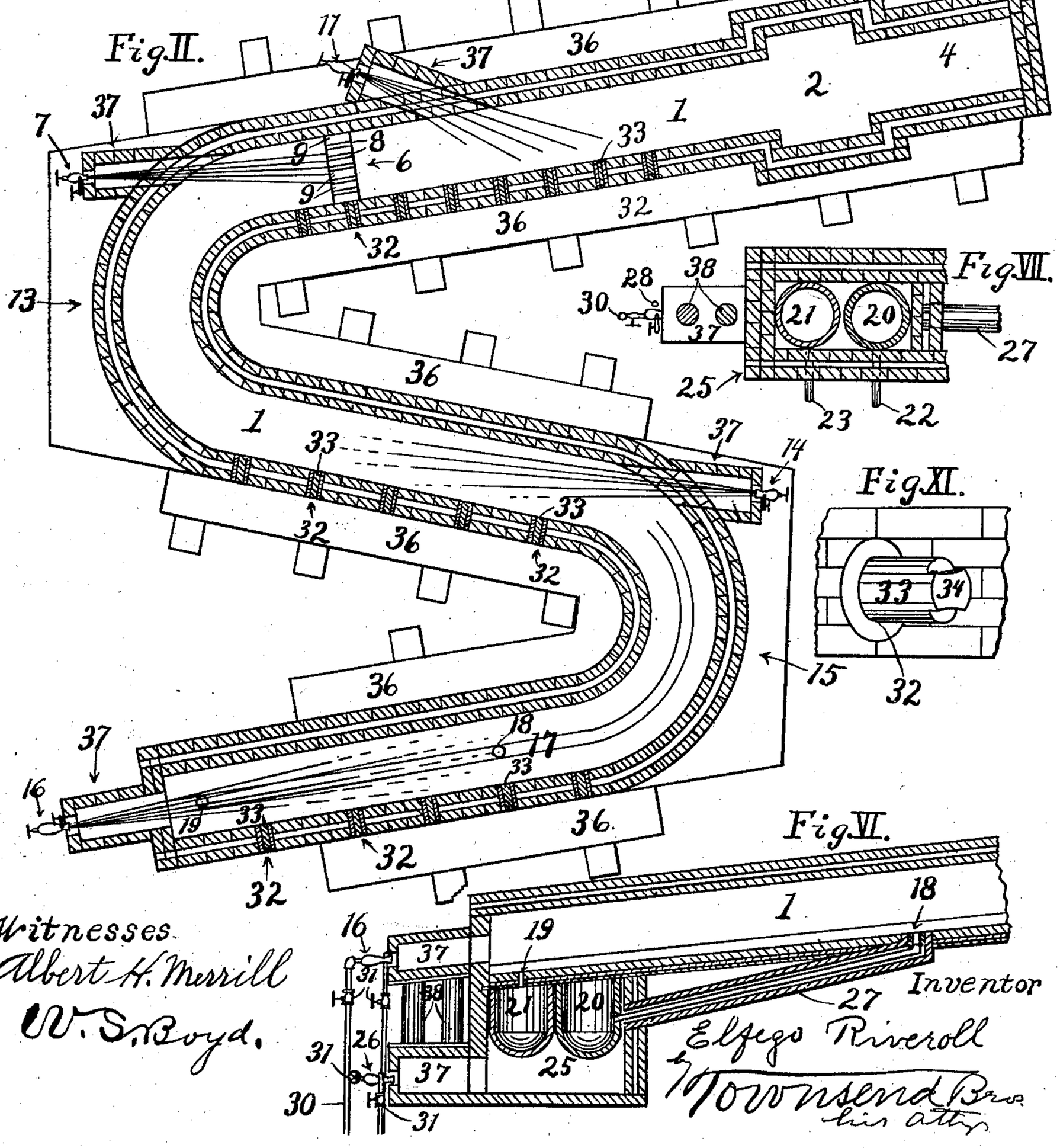

Fig. VII.

Fig. XI.

Fig. VI.

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No. 748,561. Patented December 29, 1903.

UNITED STATES PATENT OFFICE.

ELFEGO RIVEROLL, OF LOS ANGELES, CALIFORNIA.

SMELTING-FURNACE.

SPECIFICATION forming part of Letters Patent No. 748,561, dated December 29, 1903.

Application filed April 11, 1902. Serial No. 102,461. (No model.)

To all whom it may concern:

Be it known that I, ELFEGO RIVEROLL, a citizen of Mexico, residing at Los Angeles, in the county of Los Angeles and State of California, have invented a new and useful Improvement in Smelting-Furnaces, of which the following is a specification.

My invention relates to smelting-furnaces.

An object of this invention is to provide an improved practical smelting-furnace in which the process of smelting may be conducted with crude petroleum as fuel, and an important feature of this invention whereby I accomplish this object embraces a chamber adapted and arranged for confining and conveying ore in a determined direction and a succession of hydrocarbon-burners adapted and arranged for projecting their flames and heat therefrom toward the ore and along said chamber in a general direction the reverse of the ore travel. Desirably said chamber is sinuous—that is to say, it is an inclined chamber having bends and the floor having a varying pitch, and means are provided for forcibly projecting a series of flames through the chamber in a direction the reverse of the ore travel.

This invention is to be distinguished from ore-roasting furnaces provided with fireplaces and which fan hot air into inclined chambers for roasting purposes.

The main principle of this invention consists in the application of a smelting heat to a body of ore confined in an inclined sinuous chamber. In its passage through the furnace the ore is subjected to an increasing temperature whereby it is gradually smelted or reduced to the desired liquid state in which the metal or more valuable portion is the more readily separated from the slag or waste portion. In this manner the greatest amount of the heat is utilized, as the heat from each succeeding burner along the furnace is compelled to travel a longer distance over the material before it can escape through the smoke-stack at the upper end of the furnace. Owing to this utilization of the heat a large amount of material may be treated in a comparatively small furnace.

By arranging the furnace on an incline from the horizontal it may be supported entirely on the ground, thereby avoiding the cost of heavy foundations and the necessity of elevating the material to be treated to the top of a tall stack or cupola. A more perfect control of the heat can also be secured, and it can be varied at will to suit the different ores and the different stages through which it must pass on its journey down the bottom of the furnace.

The invention consists in the improved construction and novel arrangement of parts of such furnace, as will be hereinafter more particularly set forth.

The accompanying drawings illustrate the invention.

Figure I is a perspective view of one form of furnace embodying my invention. Fig. II is a horizontal longitudinal sectional view of the same. Figs. III, IV, and V are transverse sectional views of the furnace, taken at different points along its length. Fig. VI is a vertical longitudinal sectional view of the lower end of the furnace. Fig. VII is a horizontal sectional view through the top of the retort-chamber at the lower end of the furnace. Fig. VIII is a sectional detail of a portion of the bottom of the furnace near its lower end. Fig. IX is a sectional view through one of the burners. Fig. X is a top plan view of the feeder. Fig. XI is a detail view.

In practicing my invention I form an inclined serpentine or zigzag chamber or furnace 1, at the upper end of which I provide a flue 2 and a feeding-hopper 3. The walls of the furnace or chamber are preferably hollow or provided with a dead-air space to better retain the heat. The flue or chimney may be of any suitable form and height, and the hopper is arranged upon the side of the flue opposite the furnace, so as to communicate with the furnace on a direct line through the base of the flue. A short conduit 4 is preferably arranged from the bottom of the hopper to the flue, and any suitable feeder 5 may be arranged to regulate the discharge of the ore from the hopper to the conduit. The conduit is preferably of smaller area in cross-section than the furnace, so that it must be kept full to supply the amount of ore required by the furnace, thereby preventing the passage of any of the products of com-

bustion through the conduit into the hopper. The inclination of the floor of the conduit is steeper than the floor of the furnace, so that the ore will readily pass down into the furnace after it has been fed into it from the hopper. After passing into the furnace the ore gradually slides down the bottom of the furnace until it strikes an obstruction or breaker 6, where it is checked sufficiently to permit the heat of the first smelting twyer or burner 7 to partly melt it or reduce it to a liquid form. This breaker is preferably formed from a row of fire-bricks 8, set up across the bottom of the furnace at a sufficient distance apart to permit the partly-melted or semiliquid portion to pass and yet to prevent the passage between them of the larger particles of the ore. Flat slabs 9 of fireproof material may be arranged at or near the tops of the bricks substantially parallel with the bottom of the furnace to add strength to the wall of bricks and to assist in breaking up the flame from the burner, and thereby rendering it more effective upon the ore. The slabs may fit in notches 10 in the sides of the brick or be held in position in any other suitable manner. The burner 7 is arranged at the first curve or bend in the furnace substantially in a line with the straight or section portion that communicates with the flue, so that its heat strikes the lower portion of the ore with its full force and from there passes up over the entire mass of ore and partly heats or roasts it. To further roast the ore, an auxiliary twyer or burner 11 is arranged to project into one side of the straight portion of the furnace above the burner and subject the mass of slowly-moving ore to a heat sufficient to drive off the fumes and otherwise prepare it for the smelting process farther down the furnace. The twyer projects through a suitable opening 12 at one side and its heat strikes the other wall farther up and is deflected back over the ore and finally passes out through the smoke stack or flue 2. The furnace is preferably formed of a greater area in cross-section at the flue than it is toward the first curve, preferably tapering from the flue to the obstruction near the curve in order to provide sufficient room for the mass of ore that will be necessary to properly supply the furnace after the ore is melted and becomes more compact. After the ore has been reduced sufficiently by the first burner to pass the breaker 6 it passes down around the first curve or bend 13 and starts down the second straight portion of the furnace, where it is subjected to the action of the heat from the second twyer or burner 14. The ore in the second step of its treatment is rendered more liquid and flows more freely than in its first treatment, and therefore the bottom of the furnace must be less steep or inclined than is necessary in the first section. From the second section of the furnace the ore passes down around the second curve 15 and enters the third or last section, where it is subjected to the action of the last twyer or burner 16. In its passage through this section the ore is subjected to a sufficient heat to render it so liquid that it readily separates and the metal or heavier portion sinks to the bottom. To further facilitate the separation of the metal from the slag or dross, I prefer to depress the bottom of the furnace or recess it longitudinally, as shown at 17. In the drawings I have shown this depression as substantially trough-shaped, although it is evident that the inclination of the bottom could be extended from one side to the other, so as to cause the depression to be at one side instead of along the center of the floor, or it could be formed otherwise than trough-shaped.

The bottom of the furnace in the last section is provided with suitable openings 18 and 19, through which the metal and slag escape to enter retorts or receptacles 20 and 21 and from which it is drawn through gates or openings in the usual manner and delivered in molds or ingots (not shown) through pipes 22, 23, and 24. The opening 18 is located near the bend or curve 15 and is directly in the bottom or lowest portion of the depression 17 and is of such a size as to permit only the purest portion of the metal to enter, while the slag and a small portion of the metal passes down to and escapes through the opening 19. As the material passes down toward the final discharge-opening 19 it is subjected to the heat of the last burner, and is thereby rendered so liquid that when it flows into the crucible 21 the metal portion will readily settle to the bottom of the crucible, from where it can be tapped or drawn off at suitable intervals through the pipe 24, while the slag flows off through the pipe 23. The last section must be more nearly horizontal than the others owing to the increasing fluidity of the melted material.

To prevent the cooling of the contents of the retorts, they are preferably located in a suitable chamber 25, into which projects a twyer or burner 26. The flue 27, through which the metal flows from the opening 18 to its retort, is inclined and preferably formed double with the outer portion closed at its upper end, but communicating with the chamber 25 at its lower end. In this manner the metal is retained in a perfectly liquid state until it can be discharged into retort 20 and from there be drawn off through the pipe 22 into the receptacle provided for its reception.

The burners employed in my furnace may be of any suitable construction, although I have shown them as consisting of ordinary oil-burners or twyers, as that form will give a constant and intense heat and can be easily regulated or controlled to suit the different circumstances or condition to which the ores under treatment must be subjected. In the form of burner shown the fuel or oil is fed through a pipe 28 to a nozzle 29 on the steam-

pipe 30, each pipe being provided with a regulating-valve 31.

Arranged along one or both sides of the furnace are openings 32, through which the progress of the smelting may be inspected in order to properly regulate the amount of ore being fed to the furnace and the amount of heat admitted through the different burners. Access may also be had through these holes to the material being treated, so that if it should become clogged or stopped from any cause a bar may be inserted to break up the mass or make it move faster. These openings may be closed by means of plugs 33, which can be removed and reinserted by means of tongs, the outer end of each plug being preferably recessed to form a shoulder or projection 34. A plug 35 may be provided for the upper opening 18 in the bottom of the furnace to prevent the escape of the melted metal until desired, access to the plug 35 being had in any suitable manner, as through one of the openings 32. The plug 35 is preferably formed as a double plug, one within the other, so that one or both may be removed to accommodate the amount of material to be discharged at that point.

A platform 36 is provided along each side of the furnace to stand upon while manipulating the ore or inspecting the interior of the furnace through the peep-holes 32 and to pass from end to end of the furnace for regulating the burners and the ore-feeder. Each burner is preferably inclosed in a supplemental chamber 37, which communicates with the furnace and extends out from the wall of the furnace. The chamber at the end of the furnace is supported above the burner for the retort-chamber by means of posts or pillars 38.

Although I have shown the furnace supported upon a frame or series of trestles 39, it is to be understood that in practical operation it is to be built upon the ground its entire length, a hillside or sloping ground being selected for its location.

In operation the ore is fed to the hopper, and from there it is delivered through the feeder into the upper end of the furnace, from whence it passes by gravity down toward the roaster and first burner. It will necessarily bank up to a slight extent against the breaker near the first bend, where it is held until the heat melts it sufficiently to pass on down in its journey. The breaker across the bottom of the furnace, which is preferably flat, is at such a distance from the burner that the flame from the burner will strike it, and any oil that may be unconsumed will be further broken up and ignited, thereby adding to the heat at this point. The ore then passes down through the furnace until it is finally delivered in suitable condition for use in the arts.

In the drawings I have shown my improved furnace as comprising three straight sections and two curves; but it is evident that the number of sections and curves may be increased or decreased or even limited to a single section without departing from the spirit of my invention, and instead of forming the spaces between the walls as dead-air spaces they may be constructed to permit of a circulation therethrough, as by forming openings at the upper and lower ends of the furnace.

What I claim, and desire to secure by Letters Patent of the United States, is—

1. In a smelting-furnace, an inclined sinuous chamber, the upper end of which is gradually tapering its entire length in cross-sectional area and provided with means for feeding ore thereto, and a plurality of hydrocarbon-burners communicating with the chamber along its length.

2. In a smelting-furnace, an inclined sinuous chamber, the bottom of which is continuous and the inclination thereof decreases toward the lower end, and burners arranged at the bends to project a volume of heat upward toward the upper end.

3. In a smelting-furnace, a sinuous chamber, the floor of the upper portion of which is flat transversely and the lower portion is depressed longitudinally, and burners along the chamber.

4. In a smelting-furnace, an inclined sinuous chamber provided with a plurality of burners, the upper portion of the chamber being provided with an obstruction and the lower portion being depressed longitudinally and provided with outlets.

5. In a smelting-furnace, an inclined sinuous chamber, the upper portion of which is provided with means for feeding ore thereto, an obstruction adjacent to the first curve consisting of a series of bricks arranged transversely across the bottom, at a distance from each other, and burners projecting into the chamber.

6. In a smelting-furnace, an inclined sinuous chamber, the upper portion of which is provided with means for feeding ore thereto, an obstruction adjacent to the first curve consisting of a series of recessed bricks arranged transversely across the bottom, at a distance from each other, slabs secured within recesses of the bricks, and burners projecting into the chamber.

7. In a smelting-furnace, an inclined sinuous chamber, the upper end of which is provided with means for feeding ore thereto, an obstruction adjacent to the first curve, a burner at each curve, and a supplemental burner between the first curve and the upper end.

8. In a smelting-furnace, an inclined sinuous chamber the upper end of which is provided with means for feeding ore thereto, and the walls are provided with openings, means for closing said openings, and a plurality of burners communicating with the chamber.

9. In a smelting-furnace, an inclined sinuous chamber, the upper end of which is provided with means for feeding ore thereto and the walls are provided with openings, means

for closing said openings, a plurality of burners communicating with the chamber, and a platform along each side of the furnace.

10. In a smelting-furnace, an inclined chamber, the upper end of which is provided with means for feeding ore thereto and the lower end is provided with a plurality of outlets, one of which is located at a distance from the end for the discharge of the purer metal, retorts for the outlets, and a plurality of burners communicating with the chamber.

11. In a smelting-furnace, an inclined sinuous chamber, the upper end of which is provided with means for feeding ore thereto, and the lower end is depressed longitudinally along its bottom, the depressed portion being provided with a plurality of openings, one of which is near the last curve, a retort for each opening, and a plurality of burners communicating with the chamber.

12. In a smelting-furnace, an inclined sinuous chamber, the upper end of which is provided with means for feeding ore thereto and the lower end is provided with a longitudinally-arranged substantially trough-shaped depression, the bottom of the depression being provided with two outlets, one of which is near the last curve, a retort therein, an inclined conduit leading from said upper outlet to one of the retorts, means for heating the retort-chamber, and a plurality of burners communicating with the chamber.

13. In a smelting-furnace, an inclined sinuous chamber, the upper end of which is provided with means for feeding ore thereto, and the lower end is provided with a plurality of outlets, one of which is near the last curve, means for closing said outlet, a retort-chamber below the lower end of the furnace, retorts therein, one of which is provided with one discharge and the other with two, a double-walled conduit leading from the upper outlet to the retort provided with a single discharge, and a plurality of burners communicating with the furnace-chamber.

14. In a smelting-furnace, an inclined chamber, the bottom of which is flat transversely at the upper portion and is depressed longitudinally at the lower portion.

15. In a smelting-furnace, an inclined chamber, provided with a succession of burners, the bottom of the upper portion of the chamber being flat transversely and provided with an obstruction, and the bottom of the lower portion is depressed longitudinally and provided with outlets for the molten material.

16. In a smelting-furnace, an inclined chamber, the bottom of which is provided with a plurality of outlets, a retort near the lower end of the chamber, a double flue extending from one of said outlets to said retort, a chamber inclosing said retort, one section of the double flue communicating with the chamber, and the other section of the flue communicating with the retort.

17. In a smelting-furnace, an inclined chamber, the bottom of which, near its lower end, is provided with outlets, a plurality of retorts, one of said outlets communicating with one of said retorts, and a double flue extending from the other outlet to the other retort, a chamber inclosing both of said retorts, one section of the double flue communicating with the chamber, the other section of the double flue communicating with one retort and with the first-mentioned chamber.

18. In a smelting-furnace, an inclined chamber, the walls of which are provided with openings and the bottom, near its lower end, is provided with outlets, the upper outlet being adjacent to one of the openings in the wall and provided with a removable plug.

In testimony whereof I have signed my name to this specification, in the presence of two subscribing witnesses, at Los Angeles, in the county of Los Angeles and State of California, this 5th day of March, 1902.

E. RIVEROLL.

Witnesses:
W. S. BOYD,
JAMES R. TOWNSEND.