No. 742,406. PATENTED OCT. 27, 1903.

O. H. ELIEL.

SMELTING FURNACE.

APPLICATION FILED JULY 9, 1902.

NO MODEL. 4 SHEETS—SHEET 1.

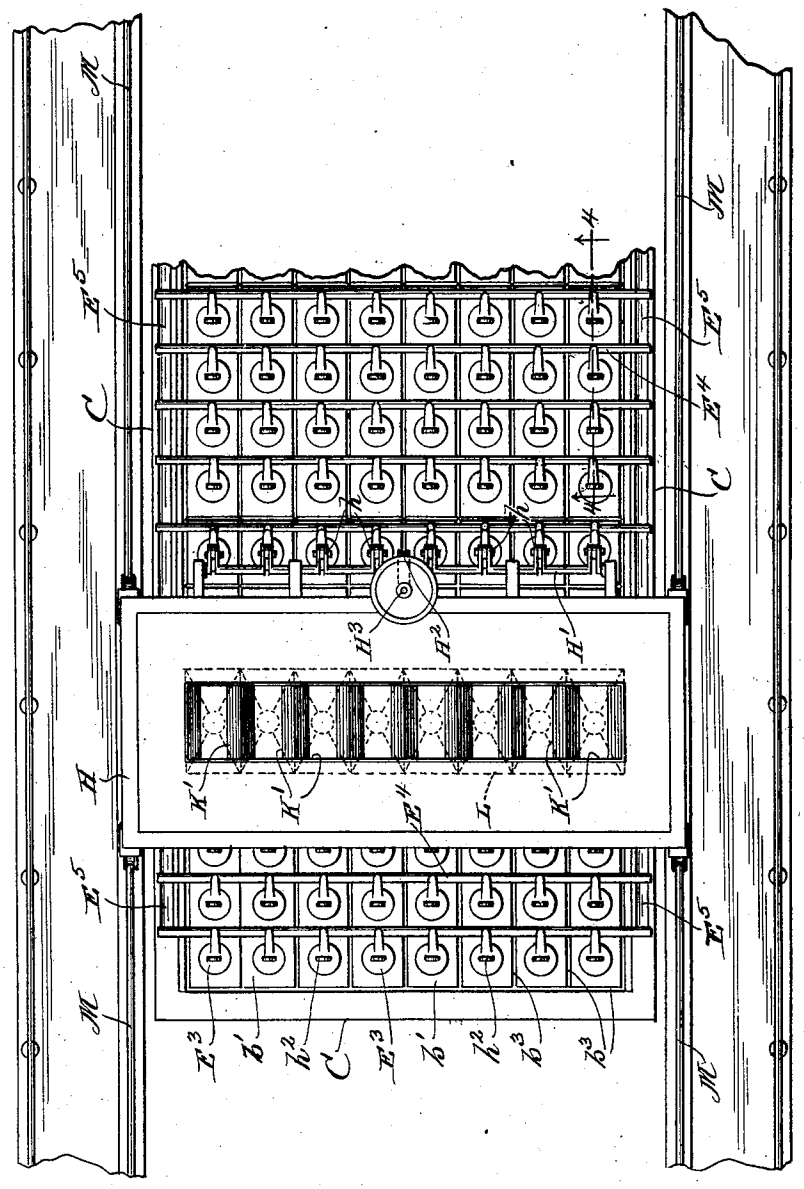


Fig. 1.

Witnesses:
R. J. Jackson
Annie M. Adams.

Inventor:
Oscar H. Eliel
Jno. H. Whipple & Co.
Atty

THE [illegible] PRINTING CO., PHOTO-LITHO., WASHINGTON, D. C.

No. 742,406. PATENTED OCT. 27, 1903.

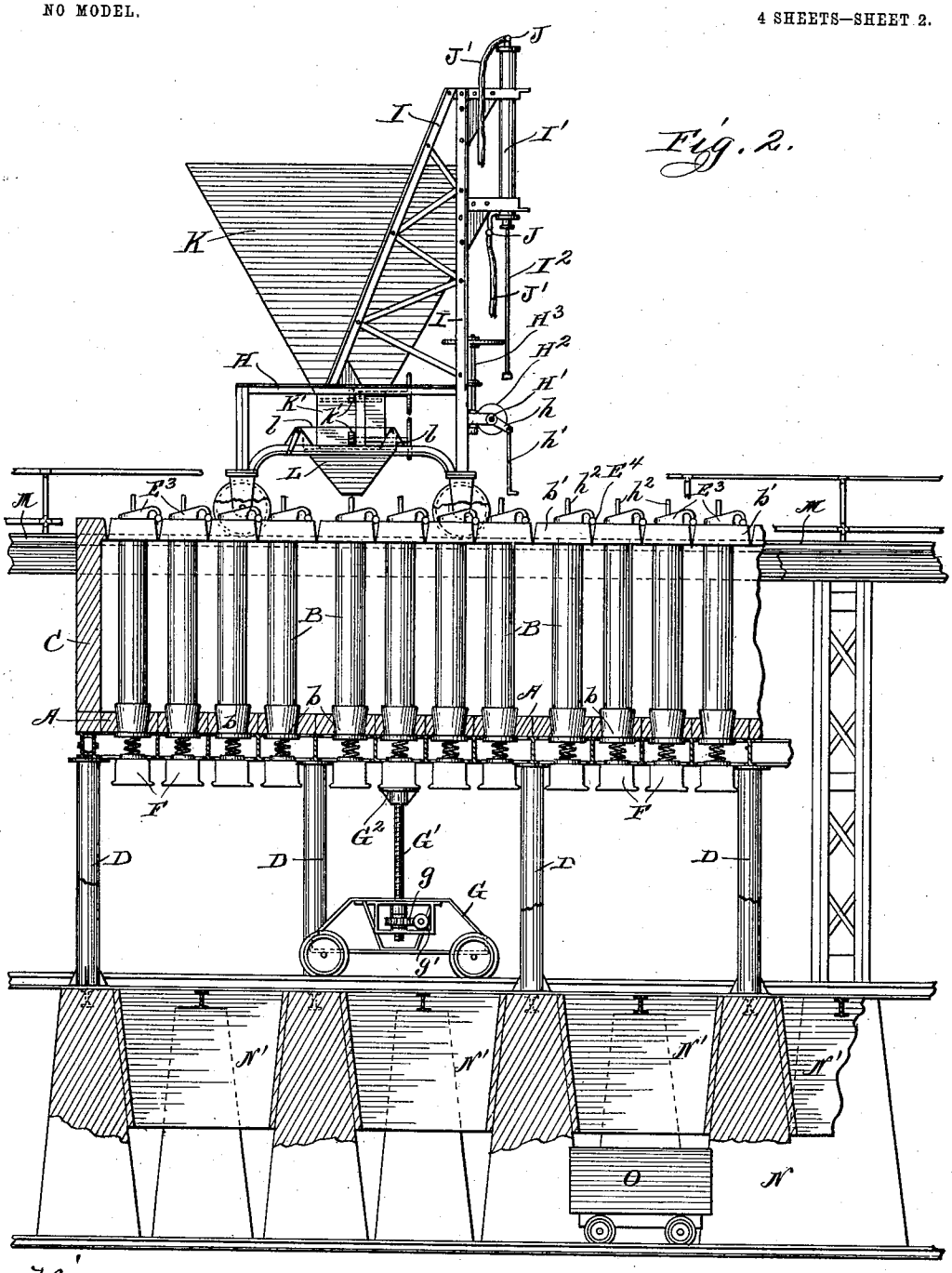
O. H. ELIEL.

SMELTING FURNACE.

APPLICATION FILED JULY 9, 1902.

NO MODEL. 4 SHEETS—SHEET 2.

Fig. 2.



Witnesses:
R. J. Jacker,
Annie M. Adams.

Inventor:
Oscar H. Eliel
By Jno. H. Whipple
Atty.

THE NORRIS PETERS CO., PHOTO-LITHO., WASHINGTON, D. C.

No. 742,406. PATENTED OCT. 27, 1903.

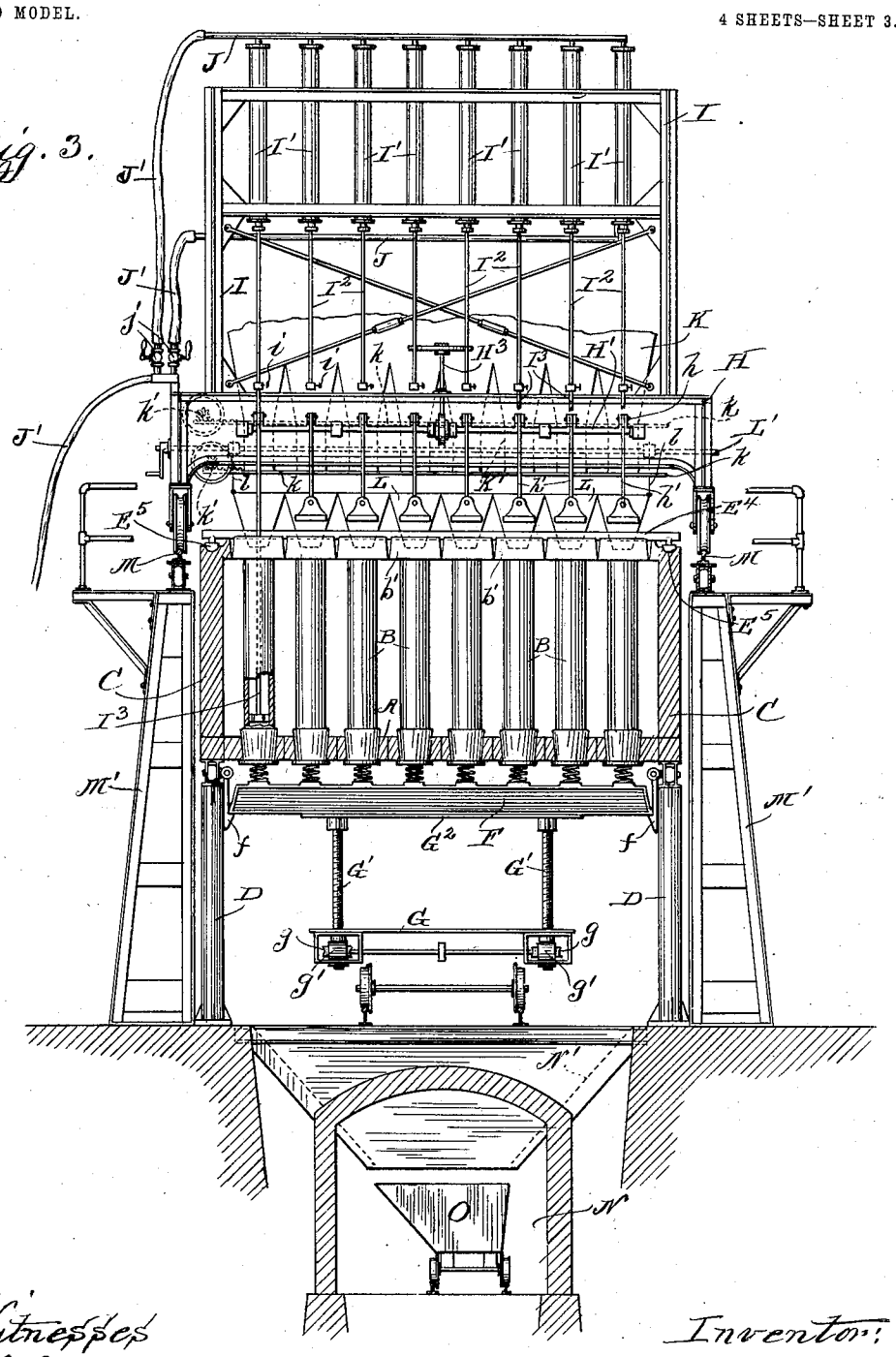
O. H. ELIEL.

SMELTING FURNACE.

APPLICATION FILED JULY 9, 1902.

NO MODEL. 4 SHEETS—SHEET 3.

Fig. 3.



Witnesses:
R. F. Jacker
Annie M. Adams

Inventor:
Oscar H. Eliel
By Jno. H. Whipple
Atty.

THE NORRIS PETERS CO., PHOTO-LITHO., WASHINGTON, D. C.

No. 742,406. PATENTED OCT. 27, 1903.

O. H. ELIEL.

SMELTING FURNACE.

APPLICATION FILED JULY 9, 1902.

NO MODEL. 4 SHEETS—SHEET 4.

Fig. 4.

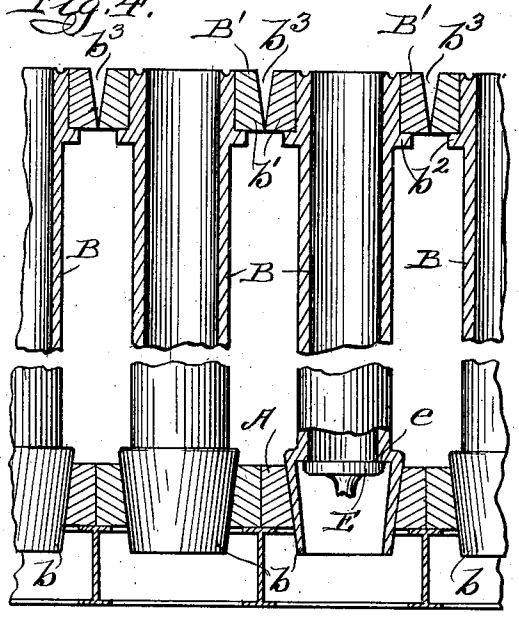


Fig. 5.

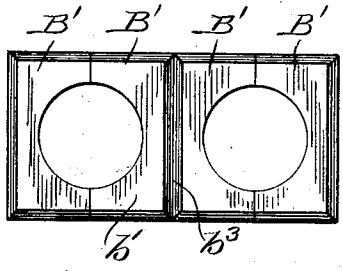


Fig. 6.

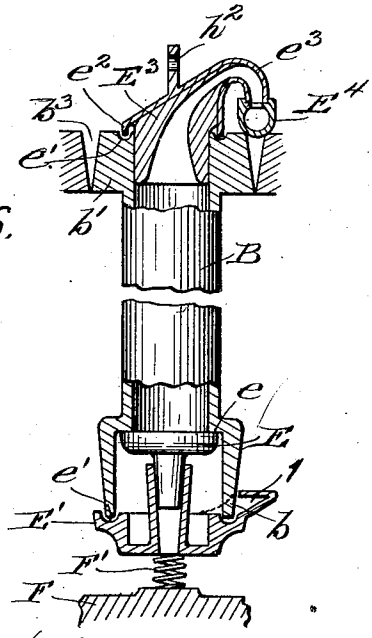
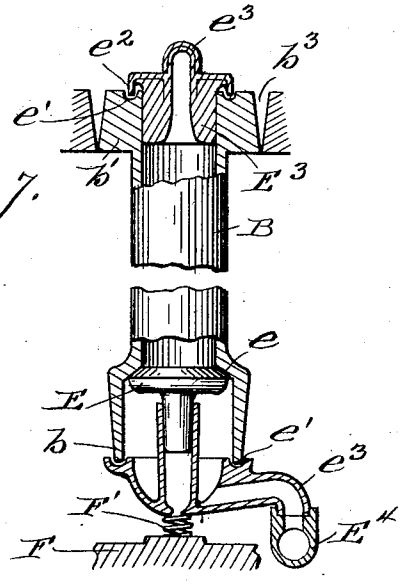


Fig. 7.



Witnesses:

R. F. Jacker

Anne M. Adams

Inventor:

Oscar H. Eliel

By Jno. N. Whipple

Atty.

THE NORRIS PETERS CO., PHOTO-LITHO., WASHINGTON, D. C.

No. 742,406. Patented October 27, 1903.

UNITED STATES PATENT OFFICE.

OSCAR H. ELIEL, OF LASALLE, ILLINOIS.

SMELTING-FURNACE.

SPECIFICATION forming part of Letters Patent No. 742,406, dated October 27, 1903.

Application filed July 9, 1902. Serial No. 114,908. (No model.)

To all whom it may concern:

Be it known that I, OSCAR H. ELIEL, of Lasalle, in the county of Lasalle and State of Illinois, have invented certain new and useful Improvements in Smelting-Furnaces, of which the following is a specification.

The invention relates to zinc-smelting or other furnaces in which air-tight retorts are used to contain the charge of ore and coal to be reduced. As most commonly constructed furnaces of this class have the retorts arranged horizontally and in connection with openings in the side or front wall of the retort-chamber, through which access to the retorts is had for charging and cleaning them and for connecting the condensers therewith. The working of furnaces so constructed necessarily requires much manual labor; and the chief object of my improvements is to provide a furnace of this class in which the retorts are arranged vertically and adapted to be worked by the aid of machinery designed to be used in connection therewith.

Among the other objects are to provide certain details of construction of the retorts whereby they are adapted to the uses intended, to provide suitable means for closing the retorts, to provide suitable condensers to be used in connection therewith, to provide means for cleaning and charging the retorts, and in other respects provide for an improved construction and economic working of the furnace.

I attain these objects by the means illustrated in the accompanying drawings, in which—

Figure 1 is a fragment of a top or plan view of a furnace of the class described containing my invention. Fig. 2 is a side elevation of the same. Fig. 3 is an end elevation, partly in section. Fig. 4 is a detail showing a fragment of an enlarged vertical section, taken on the line 4 4 of Fig. 1. Fig. 5 is a detail showing a section of the top of the chamber. Fig. 6 is a detail showing one of the disconnected retorts with means for closing the ends thereof, the figure being fragmentary and partly in vertical section. Fig. 7 is a view similar to that of Fig. 6, but showing a modification.

In the drawings, A designates the bottom of the retort-chamber, which is preferably composed of large fire clay brick supported upon a framework of metallic I-beams, longitudinal and cross, and it has tapering openings for the lower ends of the retorts B, which are supported by having their lower tapering ends set in the openings of the bottom. The extreme lower end *b* of the retorts extends sufficiently through the opening in the bottom to connect with the closing means, as hereinafter explained, and the taper resting upon the incline of the sides of the opening serves to support the retort in its vertical position. The side and end walls C of the chamber are supported upon the bottom and connected at the corners by means of a frame structure adapted to sustain the walls against lateral displacement; also, tie rods or beams at the top may be used additionally. The upper ends *b'* of the retorts are made square and preferably slightly tapering upward and projecting laterally, so as to meet one another, the entire lot fitting together within the upper edge of the side and end walls, so as to cover the inclosed area and form the top of the chamber, as seen in Fig. 6, each retort forming and supporting a surrounding section of the top of the chamber. They may, however, be made round or of other shape with a projecting ledge b^2, adapted to support a brick or a number of bricks B', provided with concaved or other shaped inner sides adapted to fit around the upper end of the retort and unite therewith and with one another in a similar manner to form a section of the top of the chamber supported by the retort. In either case the V-joint b^3 around the section is to be filled with plastic fire-clay or similar suitable filling. Thus constructed the retorts severally may be removed from the chamber readily by taking out the filling and inserting a hook down through the hollow of the retort, so as to engage the bottom edge for lifting it out without disturbing the rest and leaving all other parts of the top of the chamber intact.

The entire chamber is raised up from the ground to afford considerable room for working beneath the bottom and supported upon piers or upright posts D. The bore of the retorts should be of substantially uniform diameter to permit a scraper or cleaning-tool nearly fitting the bore to be passed through and out at the bottom to clean the retort at

a single stroke, and to better the working of the stopper at the bottom the bore is preferably enlarged through that portion of the retort below the fire-line or upper surface of the bottom of the chamber.

The means for closing the bottom of the retorts consists of a plug or stopper E, which is adapted to fit in the enlarged bore at the lower end of the retort and come up against a shoulder *e*, which is arranged at the fire-line at the bottom of the retort-chamber in order to prevent the charge from falling in the retort below the fire-line in the chamber.

A retort without the enlarged bore at the bottom end in connection with a plug or stopper adapted to fit close in the bore and pass up to the fire-line would afford a less convenient and possibly impracticable means for this purpose, because it could not be worked as easily as the less-closely-fitting plug in connection with the enlarged bore and shoulder. The closing of the bore by means of the removable plug in the retort is not gas-tight and cannot practically be made so. The plug is intended merely to prevent the charge of ore in the retorts from falling below the fire-line at the bottom of the chamber.

To make the closing gas-tight, a cup-shaped flange E′ is extended laterally out from the bottom of the stem of the stopper E over the end of the retort and provided at its outer edge with an annular recess or well *e′*, concentric with the bore at the extreme lower end, in which mercury or other metal fusible at low temperature or any equivalent substance is placed, so that the lower extreme end *b* of the retort entering the well will be submerged, and so form a liquid-seal connection which will exclude the escape of gas. On one side the flange is extended upward and inward, as shown at 1, so as to form a side pocket, into which the metal from the annular well will run when the stopper is tipped over toward that side, as it may be when taken out.

The condensation from the fumes escaping around the plug E is caught in the cup-shaped flange E′ and retained therein until the plug is removed for cleaning the retort. The general tendency of the fumes being upward, ordinarily there will be only a small quantity so escaping and condensing at the bottom of the retort.

The closing for the top end of the retort consists of a cover having a hollow extension or, preferably, of a hollow plug E^3, Fig. 6, adapted to enter the bore and having a part projecting over the end of the retort and provided with an annular depending lip or flange e^2, concentric with the bore at that end and adapted to fit the annular concentric recess or well *e′*, formed therein around the bore. When the plug is placed in the bore of the upper part of the retort, the annular depending flange enters the well provided with a liquid, as described, and forms a gas-tight closing at the top in the same way as at the bottom. The hollow plug also constitutes the condenser, and the upper part of it is extended to one side and curved down, as shown at e^3, Fig. 6, so as to form connection with a trough or tubular conduit E^4, into which the condensed metal can flow. The cover or condenser with the part which enters the bore of the retort omitted, reliance for the closing being placed entirely on the connection formed by the annular well *e′* and depending flange e^2, would form a less secure closing of the top of the retort, which might serve the purpose.

In the modification shown in Fig. 7 the hollow plug E^3 for closing the top of the retort is seen in section on a plane at right angles to that of the same part in Fig. 6, and the cup-shaped flange of the stem of the plug E at the bottom of the retort is provided with a curved hollow extension e^3, the same as that shown in conjunction with the plug E^3 of Fig. 6, for the purpose of carrying off the condensation from said cup-shaped flange instead of allowing it to accumulate there, as it does with the cup-shaped-flange construction shown in Fig. 6. In the case shown in Fig. 7 the trough or tubular conduit E^4 should be supported so that it may be lowered out of connection with the part e^3 and moved a little outward from the retort previous to removing the plug E for cleaning the retort.

The retorts are arranged in rows across the retort-chamber, eight or more in a row, and a corresponding number of the stoppers E for the bottom ends is mounted on a stopper-supporting piece F, each by means of a flexible and vertically-yielding connection F′, the stoppers being arranged and positioned with relation to the retorts so that an entire row of the retorts can be opened simultaneously at the bottom for cleaning or be stopped by the manipulation of the stopper-supporting pieces. Said stopper-supporting pieces have their ends made beveling, and vibrating hooks *f*, depending from the bottom of the chamber or its frame, are adapted to engage the beveled ends when said stopper-supporting pieces are elevated between said hooks. The yielding connections are adapted to cause and permit all of the parts of the closing means at the bottom of the row of retorts to be brought into the proper relation and practically close the row by the elevation of the stopper-supporting piece into engagement with said hooks.

The stopper-supporting pieces may be handled by means of a truck G, provided with a pair of threaded shafts G′, in connection with a platform G^2, on which the stopper-supporting piece may rest and be raised and lowered by means of the screw-shafts which run through sleeves on the truck at the bottom of the shafts, which are provided with revolving nuts *g* in gear with worm-wheels *g′* and suitable mechanism connected with an automotor (not shown) on the truck for operating the shafts in unison and in reverse directions. The truck is moved on a track under the

chamber to bring the platform in proper relation with the retorts. Substantially the same means may obviously be employed in opening and closing the retorts separately or in less number than an entire row at a single operation, if desirable.

For handling the closing means at the top end of the retorts a truck H above the retort-chamber is provided, having at its front end a shaft H′ with a series of cranks h, which have hooked rods h' depending therefrom. The cranks are spaced to correspond with the retorts, so that by moving the truck on its track the hooks may be brought directly over the plugs E^3, which have upwardly-projecting staples or eyes h^2, with which the hooks are adapted to engage. The shaft is provided with a wheel H^2, which engages a worm of an operating-shaft H^3, by which the shaft H′ may be rotated, and when the hooks are lowered and engaged in the eyes a three-quarter turn of said shaft in the direction required to swing the crank upward and out from the truck will raise the plugs E^3 from a row of the retorts and carry them back under the front edge of the truck-platform, where they are held suspended until required to be put back in place. The front end of the truck H is also provided with means suitable for simultaneously cleaning a row of the retorts, which preferably consists of a suitable frame I, erected on the platform of the truck and carrying a series of air-cylinders I′, which are spaced to fall in line with the retorts as the truck is moved over the retort-chamber. Each of these cylinders has a piston-rod I^2. The lower ends of the piston-rods are enlarged and bored to receive the upper end of the scraper-rods I^3, having scrapers on the lower end, adapted to enter and scrape the interior of the retorts when brought into position over them and thrust down through them. Set-screws i may be used to hold the scraper-rods in connection with the piston-rods for each operation, after which the scraper-rods may be detached. All of the cylinders are connected at the top and bottom with air-tubes J, carried on the frame. These communicate with flexible tubes J′, connecting with a source of compressed air whereby the scrapers are operated, there being valves j, provided for admitting the air first to the upper ends of the cylinders to push the scraper-rods down into the uncovered retorts and then to their lower ends to pull them out. The truck is further provided with means for charging the retorts, which preferably consists of a hopper K, mounted on the platform of the truck and provided with a series of spouts K′, spaced to correspond with the retorts. Sliding valves k are provided and adapted to be operated, as shown in dotted lines, Fig. 3, by means of a rack bar and pinion k', for opening and closing the spouts at the top, where they join the hopper K, and also at the bottom. The spouts are adapted to hold a charge each to fill a retort, so that when the bottom valve is closed and the upper one open the coal or other reducing agent and ore from the hopper will fall down upon the bottom valve, when the upper one may be closed and will divide the charge to be delivered into the retort from the contents of the hopper.

To better secure the delivery, a frame of supplementary hoppers L is provided to fit a row of the retorts and enter slightly into the uncovered upper ends thereof, as shown in dotted lines, Fig. 3. This frame is suspended from the under side of the truck-platform on chains or cables l at the four corners of the frame. L′ is a shaft provided with a windlass at each end, and upon which the chains may be wound and unwound for raising and lowering the frame, which is to be normally raised and held up by means of a pawl and ratchet in connection with the shaft, so that the supplementary hoppers will clear the top of the retort-chamber ordinarily.

In providing means for simultaneously uncovering, cleaning, and charging a plurality of the retorts at a single operation it is not intended to limit the invention so as not to cover the same means if used for operating the retorts singly.

The track M for the truck to run upon is preferably supported upon a framework M′, which is entirely independent of the retort-chamber and its support, as the life of the chamber is of less duration than that of the other parts of the apparatus.

A subway N is provided for receiving the refuse from the retorts. This is provided with a chute N′ for conducting the discharged refuse into a dump-car O for carrying it away.

The conduits E^4 are inclined toward the sides of the chamber, where they empty into troughs E^5 for collecting the metal.

In operation the vertical retorts are not subject to lateral strain, and hence retain their form longer than when supported in any other position. They are more easily charged, and the refractory parts of the charge naturally settle to the stopped end at the bottom, not upon the sides, so that the retorts do not become so foul, but are rather self-cleaning and do not require the same care in cleaning as when placed in any other position. In renewing the charge the stoppers at the bottom of the row of retorts are first removed, then the stoppers at the top end, which will leave the row open at both ends. The covers being removed, the scrapers are brought into position and thrust through the retorts and withdrawn. Then the bottom ends are closed. Then the car is moved forward and the supplementary hoppers let down, so as to enter the upper end of the retorts, and the charge let fall into the same. After this, the supplementary hoppers being raised, the truck is backed up to bring the stoppers in position to be placed over the retorts for closing the same at the upper ends.

The furnace, having retorts arranged vertically and adapted to be filled from the top

and cleaned out through the bottom, is dependent on mechanical devices in connection therewith for its operation, because the conditions are such as to prevent approach to either the top or bottom for the purpose of opening, cleaning, or filling the retorts manually.

Having fully described my invention and the operation thereof, what I claim is—

1. In a smelting-furnace the retort construction which consists in a tube having the bore open at both ends in combination with a stopper adapted to pass into and close the bore at a distance from the end and having a cup-shaped flange projecting laterally over the bore and provided with an annular well adapted to close over the end of the tube as specified.

2. In a smelting-furnace the retort construction which consists in a tube having the bore open at both ends and enlarged at one end in combination with a stopper adapted to pass into the enlarged part of the bore and having a flange projecting laterally over the end and provided with an annular well concentric with the enlarged bore and adapted to close over the end of the retort as specified.

3. In a smelting-furnace the retort construction which consists in a tube having the bore open at both ends and an annular well concentric with the bore formed in one end of the retort, in combination with a stopper adapted to pass into the bore and having a flange projecting laterally over the end of the retort provided with an annular recess adapted to close over the end, and a cover for the other end provided with a depending flange adapted to enter the annular well concentric with the bore at that end as specified.

4. In a smelting-furnace the retort construction which consists in a tube having the bore open at both ends, the bore at one end being enlarged and an annular well concentric with the bore being formed in the other end, in combination with a stopper adapted to enter the enlarged bore and having a flange projecting over that end and provided with an annular well concentric with the bore adapted to fit over that end, and a cover for the other end provided with a depending flange adapted to enter the annular well concentric with the bore at that end as specified.

5. In a smelting-furnace the retort construction which consists in a tube with the bore open at both ends with an annular well formed in one end in combination with a condenser having a part extended laterally over the end of the retort and provided with a depending flange concentric with the bore and an upper hollow part extended to one side and curved downwardly and a metallic filling for the well as specified.

6. In a smelting-furnace the retort construction which consists in a tube with the bore open at both ends and the wall of the tube enlarged exteriorly at both ends the exterior enlargement at one end being tapered toward that end as specified.

7. In a smelting-furnace the retort construction which consists in a tube with the bore open at both ends, the bore being enlarged at one end, and the wall of the tube being enlarged exteriorly at both ends and, at the end having the enlarged bore, tapered toward the extreme end as specified.

8. In a smelting-furnace the retort construction which consists in a tube having the bore open at both ends, the walls of the tube being enlarged exteriorly at the ends and tapered toward the extreme ends as specified.

9. In a smelting-furnace the retort-chamber provided with openings in the bottom in combination with the retorts having the bore of uniform diameter, the retorts being arranged vertically in the chamber with the lower ends extended through the openings in the bottom of the chamber and the bores opening out through the bottom and top of the chamber, means for stopping the bores inward from the ends of the retorts at the fire-line in the chamber just above the bottom of the chamber, and means for making a gas-tight closing with the lower ends of the retorts outside the chamber just below the bottom of the chamber as specified.

10. In a smelting-furnace the retort-chamber provided with openings in its bottom in combination with retorts having the bores open at both ends and arranged vertically in the chamber with the lower ends extended through the openings in the bottom of the chamber, the bore opening out through the bottom and top of the chamber, the combination with closing means adapted to form a gas-tight connection with both ends of the retorts and closing means adapted to enter the bores of the retorts at their lower ends and pass up in the bore to the fire-line in the chamber just above the bottom of the chamber as specified.

11. In a smelting-furnace the retort-chamber construction which consists of the bottom part of the chamber being provided with tapering openings, the retorts having a tapering exterior part at the bottom end adapted to fit in the tapering openings of the bottom and an enlarged exterior below the fire-line of the chamber and the upper ends of the retorts having projecting enlargements adapted to fit together and form the top of the retort-chamber as specified.

12. In an apparatus of the class described the combination with the retort-chamber provided with vertically-arranged retorts, open at the top, of removable covers for the top of the retorts, a movable truck arranged over the chamber and provided with means for engaging with the covers and mechanism for operating the engaging means for raising and lowering the covers as specified.

13. In an apparatus of the class described the combination with the retort-chamber pro-

vided with vertically-arranged retorts having the bore open at both ends, removable stoppers for both ends of the retorts, a movable truck arranged over the chambers and provided with a scraper in connection with mechanism for operating the scraper as specified.

14. In an apparatus of the class described the combination with the retort-chambers provided with vertically-arranged retorts having the bore open at the top and provided with removable covers, a movable truck arranged over the chamber and a hopper provided with valves for charging the retorts as specified.

15. In an apparatus of the class described the combination with the retort-chamber provided with transverse rows of vertically-arranged retorts of removable covers for the upper ends of the retorts, a movable truck arranged over the chamber and provided with dependent hooks adapted to engage with the covers, and mechanism in connection with the hooks for operating the same to raise and lower the covers as specified.

16. In an apparatus of the class described the combination with the retort-chamber provided with transverse rows of vertically-arranged retorts with the bore open at both ends, removable stoppers for both ends of the retorts, a movable truck arranged over the chamber, and scrapers for the retorts mounted on the truck in connection with mechanism for operating the same as specified.

17. In an apparatus of the class described the combination with the retort-chamber provided with transverse rows of vertically-arranged retorts having the bore open at the top ends and provided with removable covers, a movable truck arranged over the chamber and means for charging the retorts comprising a hopper provided with suitable spouts and a vertically-movable frame of supplemental hoppers for the individual retorts suspended from the truck as specified.

18. In an apparatus of the class described the combination with the retort-chamber provided with transverse rows of vertically-arranged retorts open at the bottom of a frame-piece provided with a series of stoppers arranged to correspond with a row of the retorts and means for raising and lowering the frame-piece and automatically securing the same in connection with the bottom of the chamber as specified.

19. In an apparatus of the class described the combination with the retort-chamber provided with vertically-arranged retorts open at the bottom, of a stopper for the bottom of the retorts mounted on a frame-piece, means for raising and lowering the frame-piece, and means for securing the same in connection with the bottom of the chamber as specified.

OSCAR H. ELIEL.

Witnesses:
N. L. HEINZ,
CONRAD J. REINHARD.