F. LOUVRIER.

ELECTROMETALLURGICAL FURNACE.

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978,465. Patented Dec. 13, 1910.

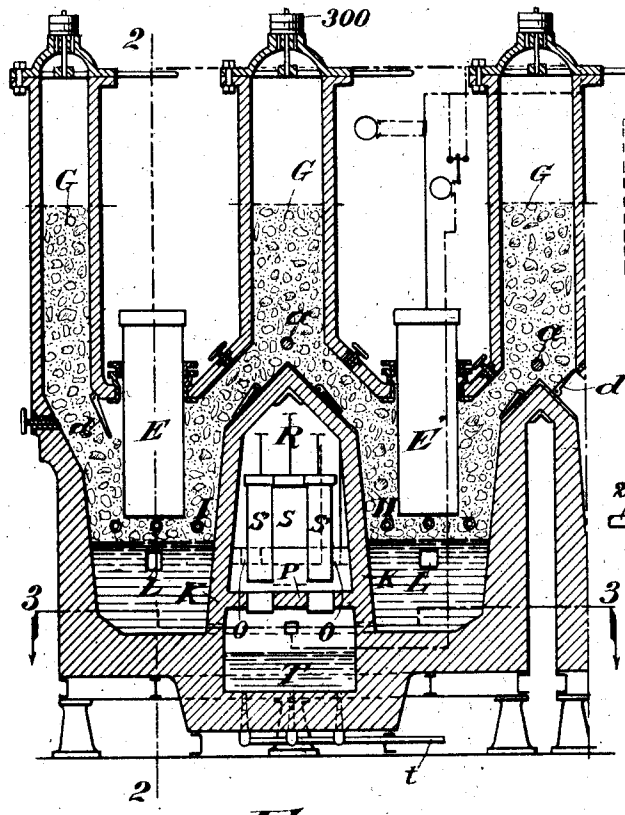

Fig. 1

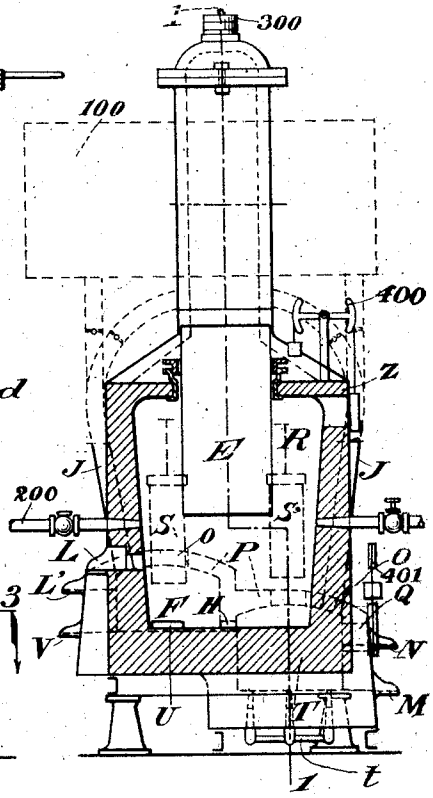

Fig. 2

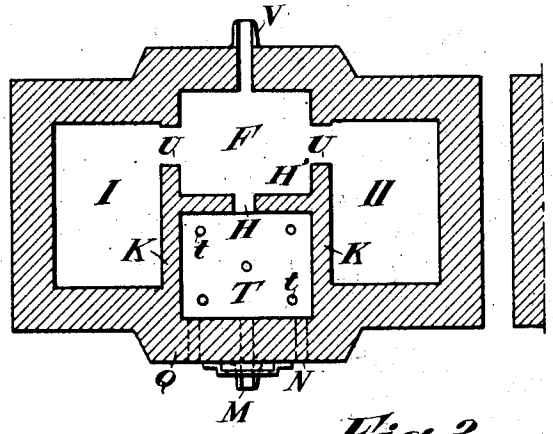

Fig. 3

Witnesses:

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UNITED STATES PATENT OFFICE.

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ELECTROMETALLURGICAL FURNACE.

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To all whom it may concern:

Be it known that I, FRANÇOIS LOUVRIER, a citizen of the Republic of France, residing at Mexico, D. F., Mexico, have invented certain new and useful Improvements in Electrometallurgical Furnaces; and I do hereby declare that the following is a full, clear, and exact description of the invention, such as will enable others skilled in the art to which it appertains to make and use the same.

The invention to be hereinafter described relates to metallurgical furnaces, and more particularly to electrometallurgical furnaces.

Broadly speaking, it comprises a plurality of reducing chambers arranged in battery formation, loading columns for feeding ore to the reduction chambers, gates for cutting off the feed of the ore, spouts for withdrawing the slags from the reduction chambers, a preliminary crucible between the reducing chambers communicating therewith and connecting them electrically, spouts for withdrawing slag and molten metal from the preliminary crucible chamber, one or two refining crucible chambers communicating with the preliminary crucible chamber, spouts for withdrawing slag and refined metal from the refining chambers, electrodes for the reduction chambers and the crucible chambers, means for introducing refining material into the crucibles, means for delivering air to the interior of the refining crucibles, means for conducting the gases from the reduction and crucible chambers, and means for burning these gases in the charging columns, when desired.

In order to more clearly disclose the construction, operation and use of the invention, reference should be had to the accompanying drawings forming part of the present application.

Throughout the several figures of the drawings, like reference characters designate the same parts.

In the drawings: Figure 1 is a central vertical longitudinal section on line 1—1 of Fig. 2; Fig. 2 is a central vertical cross section on line 2—2 of Fig. 1; and Fig. 3 is a horizontal cross section on line 3—3 of Fig. 1.

In the preferred form of the invention, a plurality of reduction chambers and crucibles are electrically arranged in series, as shown in Figs. 1 and 2, in order to present a more compact and economical construction. As constructed in this instance, two reduction chambers I and II are shown as well as two crucibles F and T, the first of the latter being in direct communication with the reduction chambers and serving to connect them electrically, by means of the metal that it contains. The reduction chambers are fed through the charging columns G, across the lower ends of which extend the iron bars *a* which act to prevent any severe shocks and consequent injury to the masonry, caused by the fall of the ore, while feeding. Communication between the loading columns and reduction chambers may be closed or opened by swinging gates *d* operated by handwheels from the exterior of the furnace, or in any other manner desired. The loading columns also serve to evacuate the gases generated during the working of the furnace. These gases can be evacuated into the atmosphere, or conducted by means of an adequate contrivance to reservoirs 100 to be utilized in the most convenient manner. If the gases are combustible, the loading columns or the upper part of the reduction chambers can be constructed to burn them, installing twyers 200 to distribute air. The upper entrance of the charging columns has a lid, which can be provided with a safety valve 300. The upper lateral part Z of each of the reduction chambers has an opening, closed with a refractory door which is handled with a balanced lever 400. The furnaces lie one against the other in order to reduce the number of loading columns. In order to withdraw the slag from the reducing chambers, spouts L are provided.

Electrodes E, E′ or groups of shunted electrodes are movably mounted to slide through airtight openings through the tops of the reduction chambers. They may be raised or lowered by any well known mechanism, and electric meters may be inserted in their circuit to indicate the strength of the current being used.

The lower space between the two reduction chambers is divided by a vertical wall H′ into two compartments, each constituting a crucible, one being for preliminary or partial refining and the other for final or complete refining. The crucibles so formed, are provided with covers, and may be operated independently one of the other. The floor of the preliminary crucible F is in the same plane as the floors of the reducing

chambers I and II, and communicates with them by way of the passages U through the lower ends of the walls K, in order to prevent the prolonged contact of the reduced metal with the reduction slag. Thus, molten metal will flow from the reduction chambers I and II through the passages U and into the preliminary crucible F. If sufficiently refined for the purpose to which it is to be put, the metal may be tapped off through the spout V, after the slag has been tapped off through the spout L', of course. But it is necessary to leave a thin layer of metal upon the floor of this crucible F to connect electrically between them the two reduction chambers.

Should the temperature in the crucible F drop below the necessary degree notwithstanding the principal electric current which constantly traverses its metal, one electrode S may be used to heat the metal, by means of a voltaic arc. Should it be desired to further refine the metal, it may be tapped from the lower part of the crucible chamber F into the refining crucible T by way of the opening H made in the partition H'. The chamber T is, of course, lower than the chamber F to allow the melted metal to be tapped from F into T. In the crucible T, two electrodes S' similar to the electrode S are placed and form an independent electrical system. Openings O for the introduction of refining agents should also be provided in the tops of the crucibles F and T. These openings, as well as the opening H, may be easily shut by closures in any well known way. The upper part of the wall Q of crucible T can have an opening provided with a refractory door handled by a balanced lever 401. The slag may be tapped off from this refining crucible through the spout N, and the refined metal through the spout M. Should the refining process require injection of air, twyers t may be used to deliver jets of compressed air into the mass of melted metal. Flues J are connected to the crucible chambers F and T to deliver the gases of reaction, either to the atmosphere, or to a suitable reservoir 100, or to the loading columns G, as may be desired. The space R situated above the crucibles and between the reduction chambers is free and of easy access for the handling of the electrodes S and S'. The furnace can have another crucible similar to crucible T and situated symmetrically to the last one with reference to the preliminary crucible F. When only partially refined metal is desired, the furnace will only have one crucible F.

The walls and the floors of the reduction chambers, as also the walls, roofs and floors of the crucibles are constructed with suitable refractory material provided with an exterior metallic armature. These walls, roofs, and floors are non-conductors of electricity and are not susceptible of entering into reaction with metal or the slags. Nevertheless, the floors and walls of the refining crucible T can be furnished with an inside lining, when the refining or separation of the metals requires it.

It is thought that the operation and use of the invention will be clear from the preceding detailed description.

Changes may be made in the construction, arrangement and disposition of the several parts of the invention, without in any way departing from the field and scope of the same, and it is meant to include all such within this application, wherein only a preferred form has been disclosed.

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

1. A furnace of the character described, comprising a plurality of reduction chambers electrically arranged in series, a preliminary crucible communicating with said reduction chambers and connecting them electrically, by way of the metal that it contains, means to prevent the prolonged contact of reduced metal with reduction slag and means for conducting an electric current through the reducing chambers and the preliminary crucible.

2. A furnace of the character described, comprising a plurality of reduction chambers electrically arranged in series and having floors made of a non-electrically conductive material, a preliminary crucible communicating with said reduction chambers and connecting them electrically, one or two refining crucibles isolated from the reduction chambers and communicating with the preliminary crucible, and means for conducting an electric current through said reduction chambers and through said preliminary crucible.

3. A furnace of the character described, comprising a plurality of reduction chambers arranged electrically in series and having floors made of a non-electrically conductive material, a preliminary crucible communicating with said reduction chambers and connecting them electrically, one or two refining crucibles communicating with said preliminary crucible, means for conducting an electric current through the reducing chambers and the preliminary crucible, and means for conducting a separate electrical current through the preliminary crucible.

4. A furnace of the character described, comprising a plurality of reduction chambers electrically arranged in series, a preliminary crucible communicating with said reduction chambers, one or more refining crucibles communicating with said preliminary crucible, means for conducting an elec-

tric current through the reducing chambers and the preliminary crucible, and means for conducting a separate electrical current through the refining crucible.

5. A furnace of the character described, comprising a plurality of reduction chambers electrically arranged in series, a preliminary crucible communicating with said reduction chambers, one or two refining crucibles communicating with said preliminary crucible, means for conducting an electric current through the reducing chambers and the preliminary crucible, means for conducting a separate electrical current through the preliminary crucible, means for conducting a separate electrical current through said refining crucible, means for feeding material to the reduction chambers and means for cutting off the feed of material from one or more of the reduction chambers.

6. A furnace of the character described, comprising a plurality of reduction chambers electrically arranged in series, a preliminary crucible communicating with said reduction chambers, one or two refining crucibles communicating with said preliminary crucible, means for conducting an electric current through the reducing chambers and the preliminary crucible, means for conducting separate electrical currents through the preliminary and refining crucibles, means to close the space between the electrodes and the top through which they pass, and means to recover the gases produced in the furnace or to burn them, if combustible.

7. A furnace of the character described, comprising a plurality of reduction chambers electrically arranged in series, a preliminary crucible communicating with said reduction chambers, one or two refining crucibles communicating with said preliminary crucible, means for conducting an electric current through the reducing chambers and the preliminary crucible, and means for injecting air into the molten metal in the refining crucible.

8. A furnace of the character described, comprising a plurality of reduction chambers electrically arranged in series, a preliminary crucible communicating with said reduction chambers, one or two refining crucibles communicating with said preliminary crucible, means for conducting an electric current through the reducing chambers and the preliminary crucible, means for injecting air into the molten metal in the refining crucible, and gas escape flues connected to said crucible chambers.

In witness whereof I have hereunto set my hand in the presence of two witnesses.

FRANCOIS LOUVRIER.

Witnesses:
LEON DOMINIAN,
G. A. GUERRA.