No. 742,419. PATENTED OCT. 27, 1903.

H. HARMET.

ELECTRIC FURNACE.

APPLICATION FILED FEB. 20, 1903.

NO MODEL. 2 SHEETS—SHEET 1.

Fig. 1.

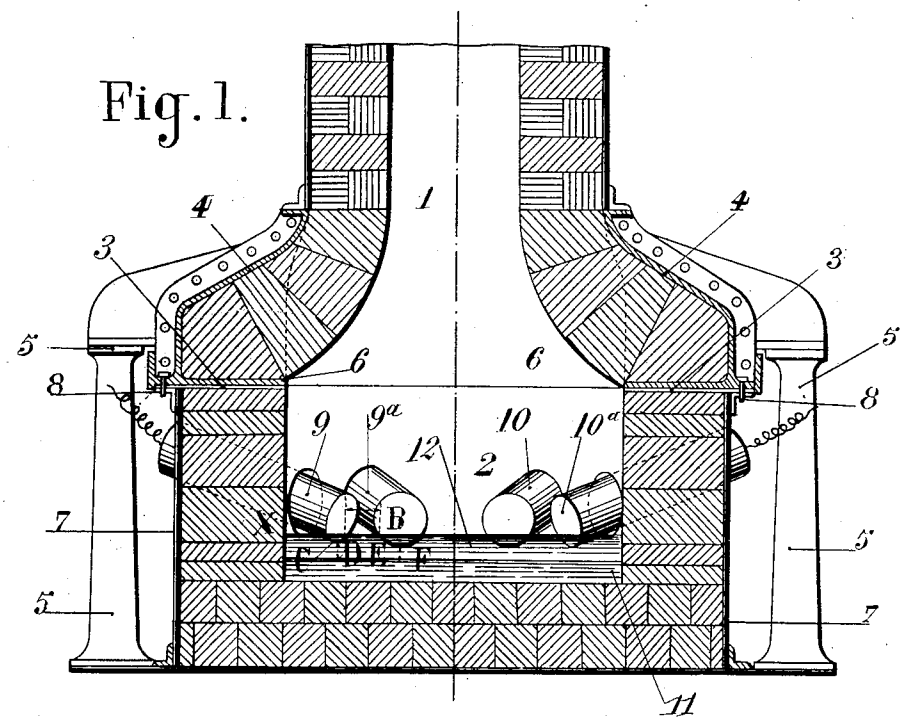
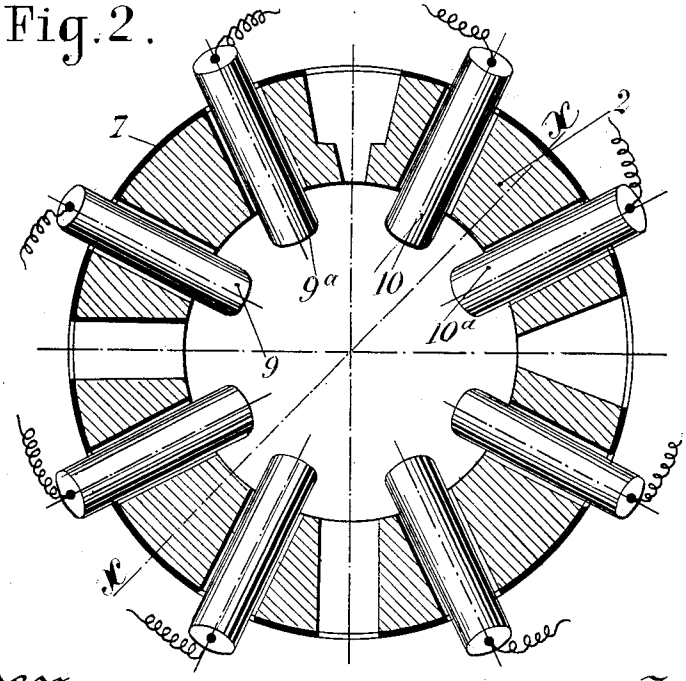


Fig. 2.



Witnesses:
Jas. C. Wobensmith.
Thomas M. Smith.

Inventor:
Henri Harmet
By J. Walter Dreyfus
Attorney.

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

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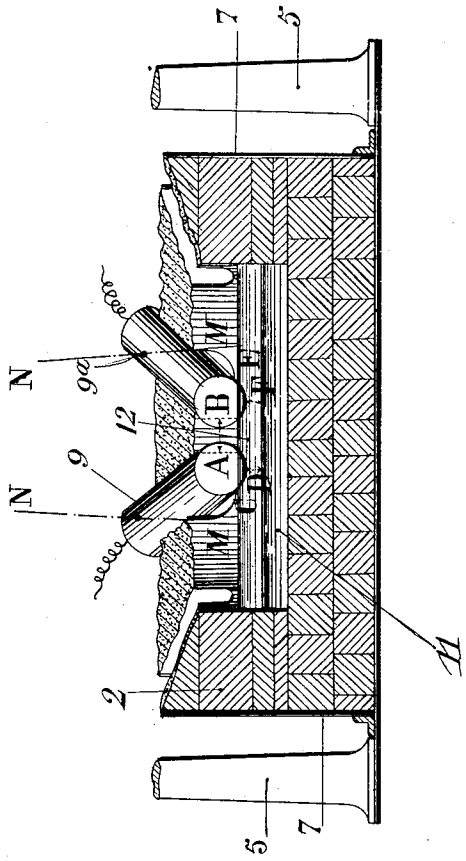
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NO MODEL. 2 SHEETS—SHEET 2.

Fig. 3.



Witnesses:
Jas. C. Wobensmith.
Thomas M. Smith.

Inventor:
Henri Harmet,
By J. Walter Dayton
Attorney.

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

No. 742,419. Patented October 27, 1903.

UNITED STATES PATENT OFFICE.

HENRI HARMET, OF ST. ETIENNE, FRANCE.

ELECTRIC FURNACE.

SPECIFICATION forming part of Letters Patent No. 742,419, dated October 27, 1903.

Application filed February 20, 1903. Serial No. 144,213. (No model.)

To all whom it may concern:

Be it known that I, HENRI HARMET, a citizen of the Republic of France, residing at St. Etienne, Loire, France, have invented a new and useful Improvement in Electric Furnaces for the Electrometallurgy of Iron and of Its Compounds, which improvement is fully set forth in the following specification.

In the electrometallurgy of iron as described in my application Serial No. 99,068 the heat produced in the transformation of the electric energy passing through a resisting material is utilized, (the resisting material being the charge, consisting of solid or molten minerals, gangue or slag, and any combustible or reducing agent.) Such a transformation has long been known and has been carried out on a large scale, notably by Cowles. In order that the transformation of energy shall take place in the most advantageous manner possible and in order to aid the transmission of heat to the solid matters to be melted, a large number of small electric currents distinct from each other are provided for in the same crucible, and the passage of the said currents through the metal-bath is avoided.

This invention has for its object a modification of the lower portion of the reducer described in application Serial No. 99,068, with a view to facilitating the arrangement of a large number of pairs of electrodes and of preventing the passage of the current through the liquid metal, its passage through the same being useless, because the heat developed there is unable to pass to the solid matters through the layer of slag.

In the annexed drawings, Figure 1 is a vertical section. Fig. 2 is a section through the axis of the electrodes; and Fig. 3 is a section on the line $x\,x$ of Fig. 2, showing two electrodes forming the poles of the same current.

In this arrangement the reducer is divided into two portions 1 2, separated by the joint 3. The upper portion 1, consisting of the "reducing vessel," properly so called, is formed of a metal casing 4, supported by the pillars 5. The rib 6 supports all the masonry. The lower portion, consisting of the "crucible," properly so called, in which fusion takes place, is formed of a metal casing 7, resting directly upon the ground, and may be independent of the upper casing. During work it is connected with 4 by the bolts 8, and the joint 3 is covered with a refractory material. Besides the usual holes for tapping the metal or slag the lower crucible is provided with the lateral openings necessary for blowing in the gases passing from the throat and for the passage of the numerous electrodes leading in the various currents for heating the slag which transmits the heat to the matters to be melted. The vertical section shows how the electrodes plunge into the slag. The horizontal section shows how the electrodes are arranged, each group serving for the passage of a separate current. Thus the two electrodes 9 9^a work together, the pair 10 10^a, and so on.

The novel arrangement of crucible independent of the vessel and carrying at its circumference all the electrodes allows the arch formed by the bottom of the vessel to be made stronger. It further allows a larger diameter to be utilized for the various holes formed for the passage of the electrodes without too greatly weakening the masonry, which in this shape is stronger and is under little vertical strain, since the masonry is vertically disposed and supports nothing above it. Lastly, it allows the electrodes to be more easily moved in order to maintain them in the relative position necessary.

In the annexed drawings, 11 is the insulated metal below the slag 12, strongly heated by its passage through the slag and there being no need to heat it again. 12 is the slag, the upper level X Y of which is maintained practically constant, owing to its flowing off as soon as formed through a tap-hole placed at a fixed level. It is to the slag that all heat should be communicated, because it can more easily transmit its heat to the solid matters to be melted—*i. e.*, to the charge plunged in it—than if the heat were applied directly from the electrode to the metal. For this purpose it is utilized as resistance between the two poles of a current, thus forcing the current to pass from one pole to another through but not outside the slag. For this object the electrodes 9 and 9^a, for example, of a current, are given two movements, the one axial, allowing the lower end of the electrode to be placed nearer or separated from the slag, the other a slight oscillatory movement, (round an axis,

such as M N, for example,) possible by reason of the play which exists between the carbon and the hole through which it passes, allows the lower ends of the two said electrodes to be moved nearer or separated from each other and the definite resistance to be regulated by the length A B, the said length A B being the length of the portion of the slag comprised between the points A and B and the said points A and B being the nearest to the points of contact between the electrodes and the slag. For the normal working of the furnace the length of resistance A B should be smaller than the sum of the two thicknesses of slag C D and E F, interposed between the electrodes and the metal in such a manner as to force the current to follow an approximately horizontal line A B into the interior of the slag sooner than pass into the metal through C D and E F; but in the crucible of a blast-furnace the solid and melted materials are not in regular layers, since the solid portions (the carbon above all, coke, or other reducing agent) plunge into those already melted. It is consequently difficult to limit the passage of the current through a single predetermined material, and the heat will therefore be communicated not only directly to the molten slag, but also to the solid materials situated above. It is even preferable in many cases when the slag can decompose to avoid as far as possible the passage of the bulk of the current through the slag from fear of introducing into the metal through the decomposition of the gangues impurities it is wished to avoid. It is therefore better to furnish to the gangue only the necessary heat for its fusion. This result is arrived at by again increasing the heights C D and E F.

Having thus described the nature and object of my invention, what I claim as new, and desire to secure by Letters Patent, is—

1. In an electric furnace, a reducer formed of two separable portions, whereof the upper portion has a flaring base supported in a metallic casing, a series of pillars supporting said metallic casing above the ground, a metallic casing lined with refractory material and resting directly upon the ground to form the crucible and lower portion of said reducer, and means for detachably securing the crucible or lower portion of the reducer to the flaring base of the upper portion of said reducer.

2. In an electric furnace, a crucible of substantially circular outline in cross-section, a flaring base of a reducer forming the dome for said crucible, said crucible detachably secured to said base, in combination with a series of electrodes arranged in groups to carry separate portions of the reducing current, said electrodes projecting centrally and downwardly through the circular wall of the crucible so as to extend partly into the slag of the crucible and partly into the material discharged from the flaring base of the material, all arranged so that in each group of electrodes the distance between adjacent electrodes is less than the sum of the thicknesses of slag interposed between the electrodes and the molten metal, substantially as and for the purposes described.

In testimony whereof I have signed this specification in the presence of two subscribing witnesses.

HENRI HARMET.

Witnesses:
HASTING W. SUNOUGH,
J. BARLET.