L. D. FARNSWORTH & M. J. BARTELL.

ELECTRIC FURNACE.

APPLICATION FILED APR. 3, 1908.

924,603. Patented June 8, 1909.

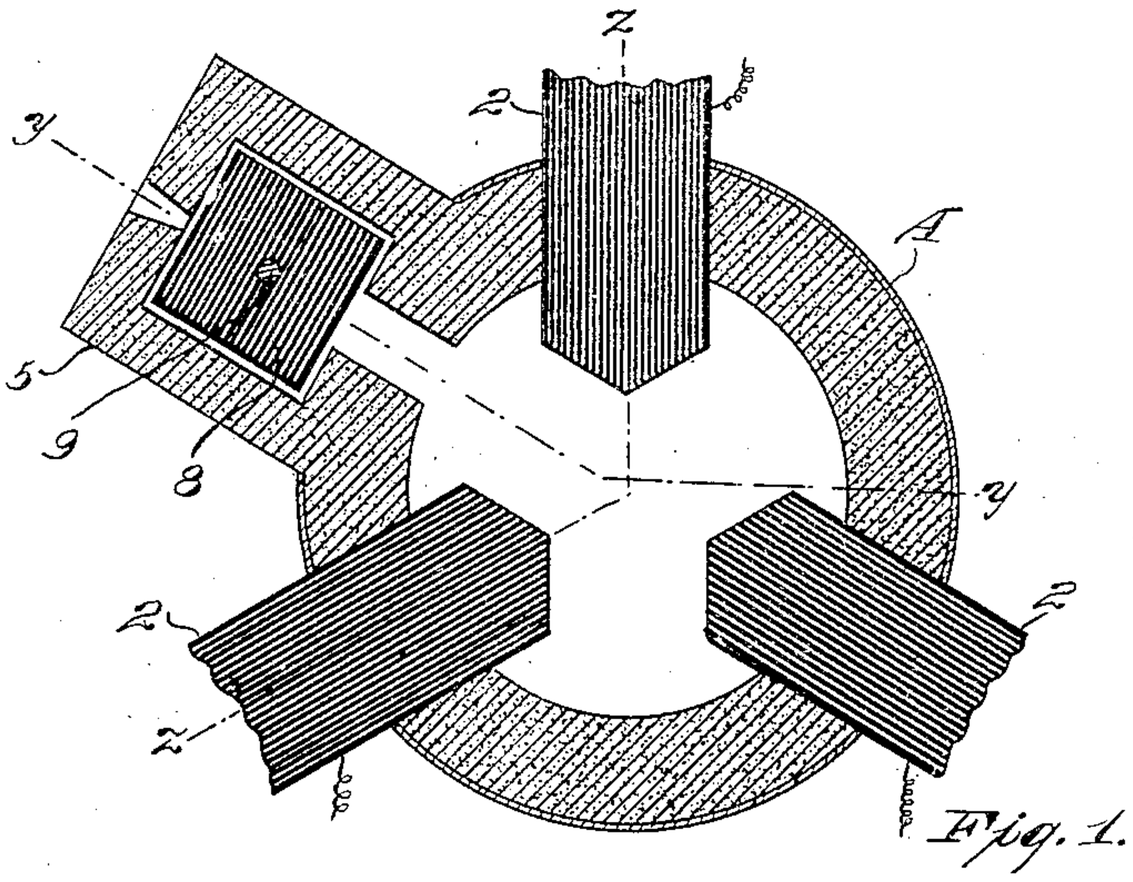

Fig. 1.

Fig. 2.

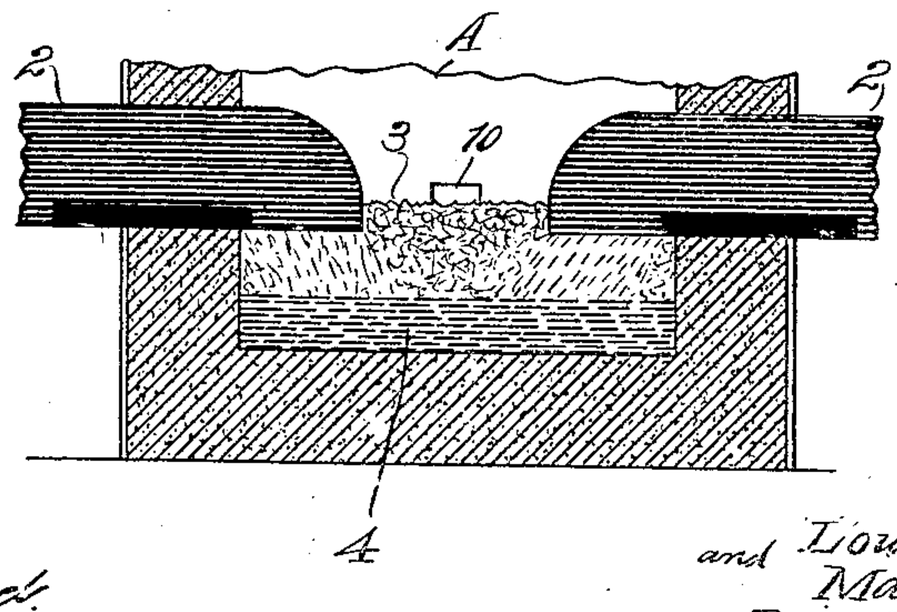

Fig. 3.

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UNITED STATES PATENT OFFICE.

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ELECTRIC FURNACE.

No. 924,603. Specification of Letters Patent. Patented June 8, 1909.

Application filed April 3, 1908. Serial No. 424,882.

To all whom it may concern:

Be it known that we, LOUIS D. FARNSWORTH, of Palo Alto, county of Santa Clara, State of California, and MAX J. BARTELL, of the city and county of San Francisco, State of California, both citizens of United States, have invented new and useful Improvements in Electric Furnaces, of which the following is a specification.

Our invention relates to electric furnaces, and especially to furnaces for smelting iron or other metalliferous ores.

One object of the invention is to provide a furnace in which the disposition of the electrodes and the passage of the electric current are entirely independent of the distance between the electrodes; thereby enabling furnaces of any desired size to be economically constructed, and to be constructed without having to take into consideration the accurate adjustments of the electrodes relative to one another.

Another object is to construct a furnace in which there is a vertical distribution of the current in the crucible. This vertical distribution makes it possible to regulate the electric current by changing the height of the metal level.

Another object is to provide a means whereby the amount or strength of the electric current may be maintained the same when the furnace is discharging its molten metal, or, in other words, is being tapped, as when the tap is closed.

Another object is to provide means whereby the molten slag itself is adapted to vary the resistance in the circuit, and therefore afford the medium for regulating the current. And our object generally is to provide an electric furnace of large capacity, which is simple and cheap of construction, wherein the electrodes are permanently built into the furnace, and in which furnace there is no requirement of a variable voltage, or of movable electrodes.

The invention consists of the parts and the construction and combination of parts as hereinafter more fully described and claimed, having reference to the accompanying drawings, in which—

Figure 1 is a horizontal section on line X—X, Fig. 2. Fig. 2 is a vertical section on line Y—Y, Fig. 1. Fig. 3 is a vertical section on line Z—Z, Fig. 1.

In the embodiment of our invention A represents the crucible of a furnace having a suitable brick lining. Suitably disposed in the reduction chamber of the furnace, and overhanging the crucible, are two or more electrodes 2, preferably built permanently into the furnace, with the electrodes arranged radially of the crucible and at a suitable distance above the bottom of the latter. The electrodes are disposed horizontally and project a short distance into the furnace, and are preferably arranged for a three-phase system. The electrodes are disposed at approximately 120 degrees apart, and the ends of the electrodes are cut wedge-shaped, so that each electrode presents a parallel end edge or surface to each of the other electrodes, and results in a more even distribution of the current through the material to be treated. By thus cutting the ends of the electrodes so that the ends are equal distances apart, the space between the three electrodes is substantially Y-shaped. Suitable electrical connections, not necessary here to be shown, are made between these electrodes and any appropriate source of electrical supply. The electrical current, however, instead of passing straight across from one electrode to the other, is designed to pass down through the slag layer in the furnace, which is represented at 3, to the body of molten metal 4, and thence across through the metal to the opposite electrode. This is what we term the vertical distribution of current in the crucible.

The quantity of current or the strength of the current passing through the body of material undergoing treatment is regulated by increasing or diminishing the depth of the slag, which is adapted during operations to be in contact with the under side of the electrodes. Thus, by employing suitable means to increase the volume of metal 4 in the crucible, the distance between the metal and the under side of the electrodes will be diminished, and the resistance offered by the slag to the passage of the electric current will correspondingly be diminished. Conversely, by lessening the depth of the metal body 4, the depth of the slag would be increased, and correspondingly the resistance to the electric current would be increased. Any suitable means may be employed to effect this variation of the depth in slag and metal. As here shown, we provide a forehearth or supplemental chamber 5 of suitable area,

having suitable connections 6 at the bottom, with the bottom of the crucible; through which connections 6 the molten metal may freely flow from the supplemental chamber to the crucible, and vice versa. The front of the supplemental chamber 5 has a tap 7 through which the molten metal may be drawn off from time to time, this tap being normally closed in a manner usual in the art.

A plunger 8 of carbon or other suitable material, and designed to practically fill the supplemental chamber operates in the supplemental chamber for the purpose of raising and lowering the level of the molten metal in the crucible; the operation of the plunger being effected by any suitable means, as the stem 9. By pushing down on the plunger a certain quantity of the metal in the supplemental chamber is displaced into the crucible, raising the metal level therein, and decreasing the thickness of the slag between the electrodes and the top of the metal. Correspondingly, by raising the plunger, the amount of metal in the crucible is decreased. The molten slag may be drawn off from time to time through a suitable aperture, as 10.

The electrodes are suitably insulated, and on their under sides they are cut away where they pass through the walls of the furnace, so that there will be no tendency for the current to follow down through the walls of the furnace to the metal, and thereby destroy the walls. The electrodes overhang the crucible so that contact could be made between the slag and the under side of all the electrodes.

In operation, the crucible is first filled with charcoal or other suitable heating and conducting material, and the electric current turned on. In a short while the charcoal is converted into a bed of glowing coals, whereupon the charge to be treated is dumped in, and after a time a body of metal, as 4, accumulates in the bottom of the crucible. The current from one electrode passes down through the slag and the metal in the bottom of the crucible, and thence travels across the bottom of the crucible through the metal and up through the slag to the other electrodes. By the lowering or raising of the plunger in the supplemental chamber, the distance through the body of slag between the electrodes and metal can be varied, thus varying the resistance in the circuit, and affording a means of regulating the current.

By suitably manipulating the plunger 8 when drawing off metal from the furnace, it is possible to maintain a constant thickness of slag between the under side of the electrodes and the top of the metal, and thereby avoid a variation in the resistance or the amount of current.

For practical and obvious reasons, the distance apart of the electrodes is generally in excess of twice the depth of the body of slag between the under side of the electrodes and the body of metal 4.

Having thus described our invention, what we claim and desire to secure by Letters Patent is—

1. In an electric furnace, the combination with the crucible thereof, of electrodes overhanging the crucible, said electrodes having inner ends normally of wedge-shape and said electrodes and crucible being arranged so that the current between the electrodes will pass downwardly through a body of slag, and thence across through the molten metal in the crucible, and a supplemental chamber at one side of the crucible in open connection with the latter, and into which chamber the molten metal will freely flow.

2. In an electric furnace, the combination with the crucible thereof, of electrodes fixed within the furnace, and overhanging the crucible, a chamber at one side of the crucible and connecting with the bottom thereof, and means operating within said chamber to displace the molten metal therein and raise the level of the molten metal in the crucible.

3. In an electric furnace, the combination with the crucible thereof, of electrodes overhanging the crucible and permanently built thereinto, and having their inner ends normally of wedge shape, said electrodes and crucible so arranged that the current between the electrodes will pass downwardly through a body of slag, and thence across through the molten metal in the crucible, and means for varying the depth of the slag between the electrodes and metal, said last-named means including a displacing chamber.

4. In an electric furnace, the combination with a crucible, of three electrodes arranged therein horizontally and overhanging the crucible, the ends of said electrodes being cut wedge-shaped, so that the space between the ends of the electrodes is substantially Y-shaped, said electrodes and crucible so constructed that the electric current in passing from one electrode to the other will distribute vertically through the slag, and horizontally through the molten metal in the crucible.

5. In an electric furnace, the combination with a crucible, of three electrodes arranged therein horizontally and overhanging the crucible, the ends of said electrodes being cut wedge-shaped, so that the space between the ends of the electrodes is substantially Y-shaped, said electrodes and crucible so constructed that the electric current in passing from one electrode to the other will distribute vertically through the slag, and horizontally through the molten metal in the crucible, and means for varying the vertical traverse of the current through the slag.

6. In an electric furnace, the combination of a reduction chamber, electrical reduction

means therein, a supplemental chamber connected with the reduction chamber, and a displacing member in the supplemental chamber for varying the amount of metal in the reduction chamber, and thereby varying the current passing through the reduction chamber.

7. An electrical furnace having a reduction chamber and having a supplemental chamber, said chambers having fluid connections whereby molten metal may flow from one to the other, electrodes in the reduction chamber, said electrodes arranged so that the electric current distributes vertically through the slag and horizontally through the molten metal in the reduction chamber, and a displacing member operating in the supplemental chamber for varying the amount of slag between the electrodes and the metal in the reduction chamber.

8. An electrical furnace having a reduction chamber and having a supplemental chamber, said chambers having fluid connections whereby molten metal may flow from one to the other, electrodes in the reduction chamber, said electrodes arranged so that the electric current distributes vertically through the slag and horizontally through the molten metal in the reduction chamber, and a plunger operating in the supplemental chamber for varying the amount of slag between the electrodes and the metal in the reduction chamber.

9. An electric furnace having a reduction chamber, electrodes in the reduction chamber, said reduction chamber having a discharge for the molten metal, and means operative through the molten metal in the reduction chamber whereby the molten metal may be drawn off without affecting the electrical current.

10. An electric furnace having a main reduction chamber and a supplemental chamber connected together at the bottom, electrodes in the reduction chamber, and a plunger in the supplemental chamber operative to raise and lower the body of metal in the reduction chamber toward and from the electrodes.

In testimony whereof we have hereunto set our hands in presence of two subscribing witnesses.

LOUIS D. FARNSWORTH.
MAX J. BARTELL.

Witnesses:
CHARLES A. PENFIELD,
FREDERICK E. MAYNARD.