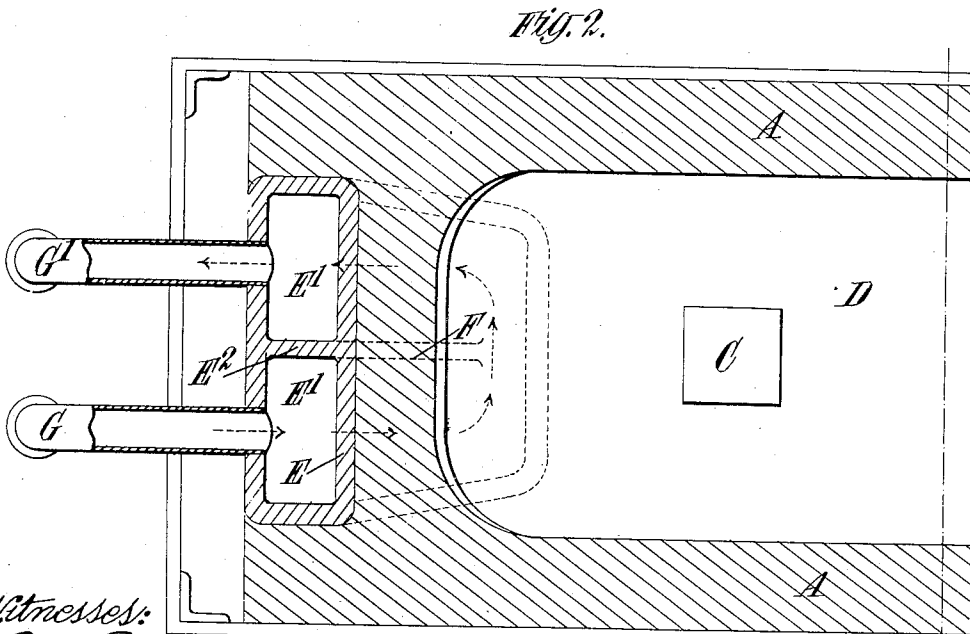
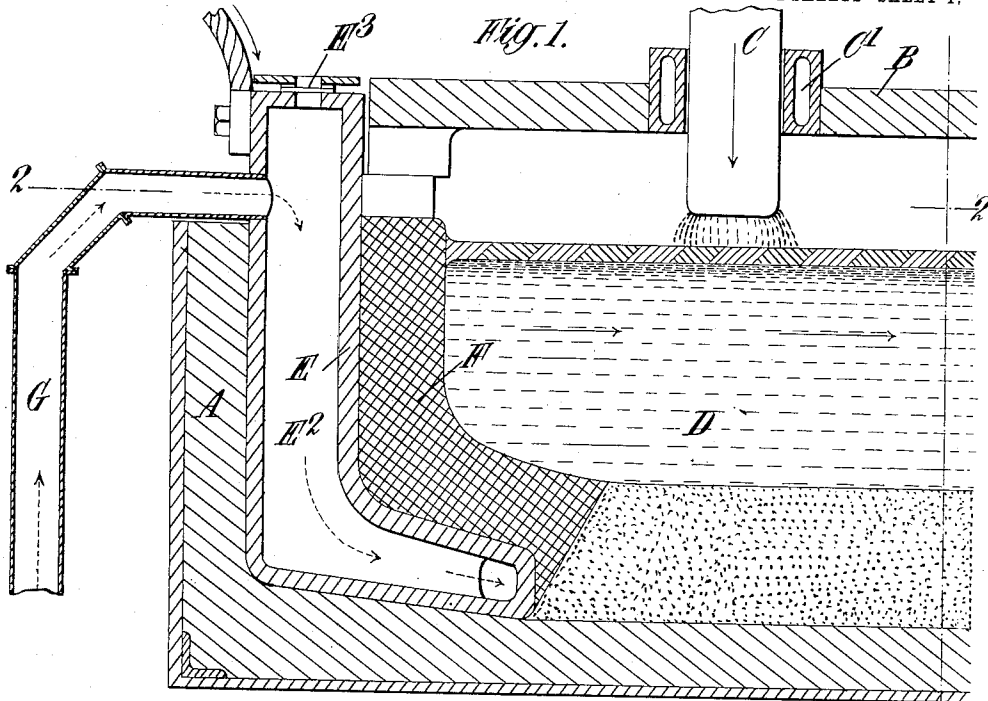


J. HÄRDÉN.
ELECTRIC FURNACE.
APPLICATION FILED DEC. 7, 1909.

967,908.

Patented Aug. 23, 1910.

2 SHEETS—SHEET 1.



Witnesses:

P. W. Pegg
E. Bachman

Inventor:

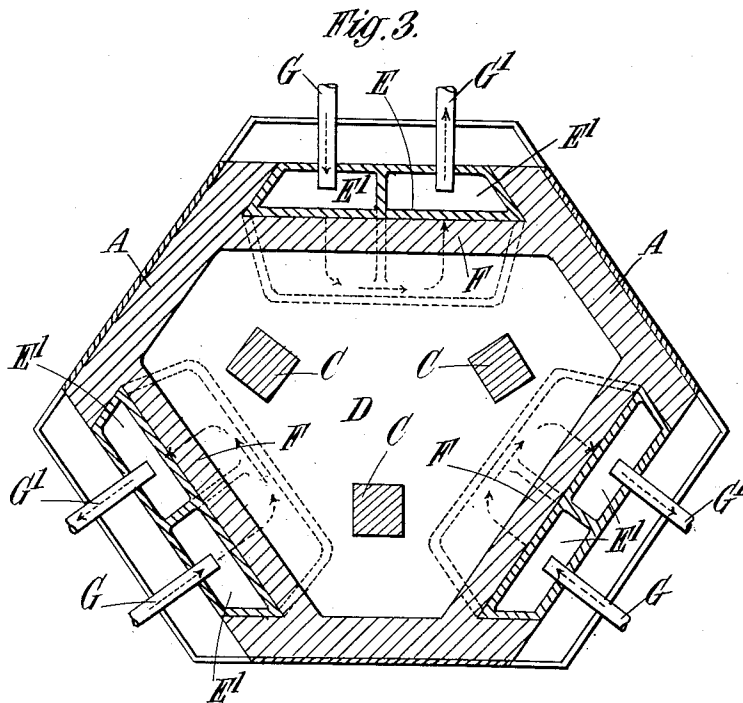
Johannes Härdén
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2 SHEETS—SHEET 2.



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UNITED STATES PATENT OFFICE.

JOHANNES HÄRDÉN, OF LONDON, ENGLAND, ASSIGNOR TO THE GRONDAL KJELLIN COMPANY, LIMITED, OF LONDON, ENGLAND.

ELECTRIC FURNACE.

967,908.

Specification of Letters Patent. Patented Aug. 23, 1910.

Application filed December 7, 1909. Serial No. 531,825.

To all whom it may concern:

Be it known that I, JOHANNES HÄRDÉN, a subject of the King of Sweden, residing at 20 Abchurch Lane, in the city and county of London, England, have invented certain new and useful Improvements in and Relating to Electric Furnaces, of which the following is a specification.

This invention relates to electric furnaces and has for its chief object to improve the construction of and mode of working such furnaces, so as to enable large quantities of ore or metal to be readily and efficiently treated in them.

The invention has particular reference to furnaces of the kind in which the heating of the charge is effected partly by means of electric arcs and partly by means of a current passing through high resistance terminal plates let into the furnace walls.

The improvements are in connection with any of the known types of arc furnaces but the type of arc furnace with which the invention is particularly concerned is that in which the electric arc passes between the surface of the charge and an electrode or electrodes projecting through the roof of the furnace and situated at a short distance from the surface of the said charge. Large volumes of ore or metal cannot be efficiently dealt with in this type of furnace because the large amount of heat required to be developed at the surface of the charge rapidly destroys the arching or roof of the furnace. If the roof is arched so high as to be beyond the zone of intense heat, the loss of heat from the furnace is excessive; moreover in such a case a considerable length of the electrode or electrodes, which have to be mounted in holders let into the roof and to be fed forward as they wear away, cannot be used up, and the cost of working the furnace is consequently increased. Furthermore the large range of temperature to which the electrodes are subjected is liable to make them snap and fall into the charge, thereby spoiling the latter. A further disadvantage in the use of furnaces of this type for treating ores or metals in large bulk is that the electrode or electrodes must be of very considerable cross-sectional area in order to convey the necessarily heavy current. It is customary to employ a current of from twenty-five to twenty-eight amperes per square inch of sectional area of the electrode; as the vol-

tage employed in a large furnace containing steel, say, is comparatively low, for example eighty to one hundred volts only, the total current required to be conveyed by the electrode will be very heavy, and the manufacture of appropriate electrodes will be difficult and expensive. Nevertheless, it is desirable to impart a certain amount of the heat to the charge by means of a superposed electric arc, in order that the slag may be kept sufficiently hot to permit a quick and complete desulfurization and dephosphorization. On the other hand in furnaces in which the heat is conveyed to the charge by passing an electric current through terminal plates such as those consisting of metal plates faced with second class conductors, these plates, whether used alone, or in combination with a system for heating the surface of the charge, soon become overheated so much, if a large quantity of ore or metal is being treated, that the metal plates are melted and thereby constitute a source of danger as well as interfere with the proper action of the terminal plates.

According to this invention the furnace is provided with means for heating the surface of the charge by electric arcs, and also with means for heating the charge by conduction from terminal plates and these two means are so constructed and arranged that the total heat required to be developed can be shared by them in the most economical manner. Since the economy is increased in proportion to the increase in the share taken by the means for heating the charge by conduction, up to a certain extent, the terminal plates I employ are so constructed that they may be kept sufficiently cool to prevent them from being damaged when developing as much as fifty per cent. or more of the total heat required. By dividing the production of the total heat required in such a way that half of it or more is developed by means of the electric arc or arcs and the remainder by means of suitably cooled terminal plates, furnaces of ten, twenty, thirty and fifty tons capacity can be worked efficiently.

The terminal plates I prefer to employ are composite plates consisting of metal plates faced with second class conducting material, that is to say refractory material that becomes electrically conducting when hot, and to cool them I form the metal plates with cavities and circulate a cooling fluid therein. A

gaseous form of cooling fluid, such as air, is used in preference to a liquid, because there is the danger of the liquid entering into contact with the molten metal in the furnace through a hidden crack or otherwise.

I prefer to employ two or more arcs arranged in any well known manner for use either with direct current or single or three-phase current, and two or more terminal plates, so that I may control either source of heating independently of the other, and, if occasion arises, use one source of heating only.

In order that the invention may be clearly understood and readily carried into effect, I will now describe the same more fully with reference to the accompanying drawings, in which:—

Figure 1 is a sectional elevation, and Fig. 2 a sectional plan on the line 2—2 of Fig. 1 of half of a furnace constructed in accordance with this invention for either direct or alternating current. Fig. 3 is a sectional plan of my improved furnace adapted for working with three-phase current.

A A are the walls and B is the roof of the furnace.

C is an electrode mounted in a holder C', which can be kept cool by the circulation of a cooling fluid within it.

The composite plate forming the end wall of the hearth D consists of a cast steel plate E faced with second class conducting material F. The cast steel plate E, if solid throughout, would melt under the influence of the intense heat developed in dealing with a large bulk of metal in the furnace, and is therefore, according to one constructional arrangement for carrying out the present invention, formed with cavities E' E' and a partition E². Air, supplied by means of a fan or otherwise, enters one cavity by way of the inlet pipe G and travels in the direction of the dotted arrows to the other cavity and thence out through the exit pipe G'. A small window E³ of mica or similar material may be provided to permit inspection of the walls of the metal plate E.

The paths of the electric currents are shown by the full lined arrows. One path of the current is from the electrode C across the gap to the layer of slag on the surface of the charge, and through the slag and the molten metal beneath to the corresponding electrode in the right-hand half (not shown) of the furnace. The other path of the current is from the metal plate E, through the material F and across the charge to the corresponding composite plate at the right-hand end (not shown) of the furnace. The control of either of these circuits may be arranged to take place quite independently of the other circuit.

In Fig. 3, which shows a constructional

arrangement for working with three-phase current, three composite plates are shown arranged triangularly, and three electrodes are also provided, each of which is preferably situated in an intermediate position with respect to two of the terminal plates.

An especial advantage resulting from working the upper electrodes independently of the lower ones is that the temperature of the materials undergoing treatment can be regulated in a very practical and beneficial manner, whereas if every upper electrode co-operated with a lower one, the surface heating of the material undergoing treatment could not be regulated relatively to the heating of the submerged portions of the material.

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

1. In an electric furnace, means for heating the surface of the charge therein, a composite terminal plate situated in contact with the charge and comprising metal faced with refractory material capable of producing ohmic resistance heat by the passage of an electric current through it, and means whereby the temperature of the plate is prevented from becoming excessive.

2. In an electric furnace, means for producing an electric arc above the surface of the charge therein, a composite terminal plate situated in contact with the charge, and comprising metal faced with refractory material capable of producing ohmic resistance heat by the passage of an electric current through it, and means whereby the metal portion of the plate can be maintained comparatively cool.

3. In an electric furnace, means for producing a plurality of electric arcs above the surface of the charge therein, a composite terminal plate situated in contact with the charge, and comprising metal faced with refractory material capable of producing ohmic resistance heat by the passage of an electric current through it, and means whereby the metal portion of the plate can be maintained comparatively cool.

4. In an electric furnace, means for heating the surface of the charge therein, a plurality of composite terminal plates operating independently of the surface heating means and situated in contact with the charge and comprising metal faced with refractory material capable of producing ohmic resistance heat by the passage of an electric current through it, and means whereby the metal portions of the plates are maintained comparatively cool.

5. In an electric furnace, means for producing an electric arc above the surface of the charge therein, a plurality of composite terminal plates operating independently of the arcing means and situated in contact with the charge, and comprising metal faced

with refractory material capable of producing ohmic resistance heat by the passage of an electric current through it, and means whereby the metal portions of the plates are maintained comparatively cool.

6. In an electric furnace, means for producing a plurality of electric arcs above the surface of the charge therein, a plurality of composite terminal plates operating independently of the arcing means and situated in contact with the charge, and comprising metal faced with refractory material capable of producing ohmic resistance heat by the passage of an electric current through it, and means whereby the metal portions of the plates are maintained comparatively cool.

7. In an electric furnace, means for heating the surface of the charge therein, a plurality of composite terminal plates operating independently of the surface heating means and situated in contact with the charge, and comprising metal faced with refractory material capable of producing ohmic resistance heat by the passage of an electric current through it, and means for enabling a cooling medium to circulate in contact with the metal portion of each plate.

8. In an electric furnace, means for producing an electric arc above the surface of the charge therein, a plurality of composite terminal plates operating independently of the arcing means and situated in contact with the charge, and comprising metal faced with refractory material capable of producing ohmic resistance heat by the passage of an electric current through it, and means for enabling a cooling medium to circulate in contact with the metal portion of each plate.

9. In an electric furnace, means for producing a plurality of electric arcs above the surface of the charge therein, a plurality of composite terminal plates operating independently of the arcing means and situated in contact with the charge, and comprising metal faced with refractory material capa-

ble of producing ohmic resistance heat by the passage of an electric current through it, and means for enabling a cooling medium to circulate in contact with the metal portion of each plate.

10. In an electric furnace, means for heating the surface of the charge by means of the electric arc, and a plurality of composite terminal plates operating independently of the arcing means and situated in contact with the charge, and comprising a metal plate made hollow for the circulation of a cooling medium within it, and a facing of refractory material capable of producing ohmic resistance heat by the passage of an electric current through it.

11. In an electric furnace, a plurality of electrodes depending from the roof of the furnace to within a short distance of the surface of the charge to form arc gaps, and a plurality of composite terminal plates operating independently of the electrodes and situated in contact with the charge, and comprising a metal plate made hollow for the circulation of a cooling medium within it, and a facing of refractory material capable of producing ohmic resistance heat by the passage of an electric current through it.

12. In an electric furnace, a plurality of electrodes depending from the roof of the furnace to within a short distance of the surface of the charge to form arc gaps, and a plurality of composite terminal plates operating independently of the electrodes and situated in contact with the charge, and comprising a metal plate made hollow for the circulation of air within it, and a facing of refractory material capable of producing ohmic resistance heat by the passage of an electric current through it.

In testimony whereof I affix my signature in presence of two witnesses.

JOHANNES HÄRDÉN.

Witnesses:

WALTER J. SKERTEN,
T. SELBY WARDLE.