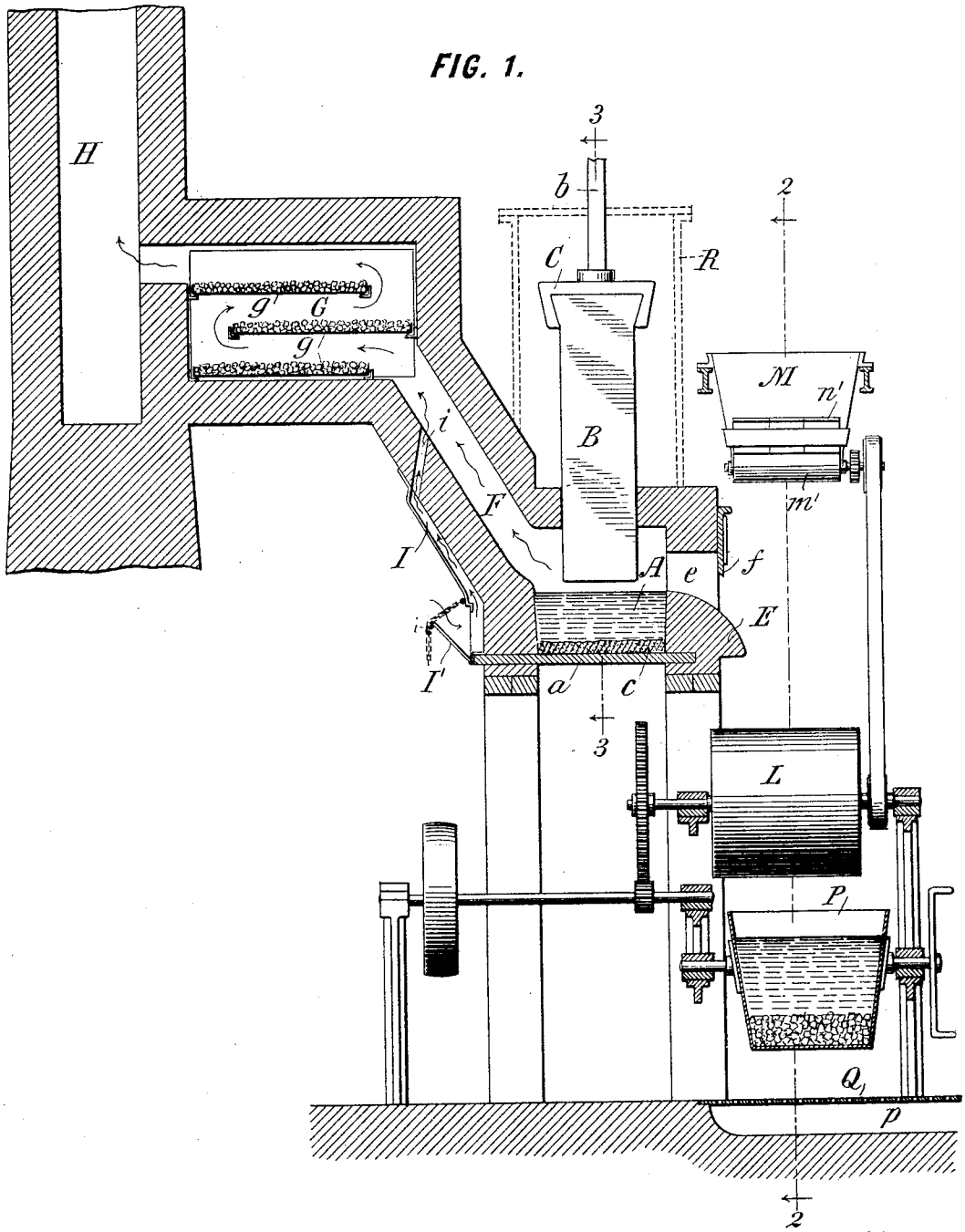
(No Model.) 2 Sheets—Sheet 1.

G. DE CHALMOT.

ELECTRIC FURNACE.

No. 588,267. Patented Aug. 17, 1897.

FIG. 1.



WITNESSES:

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H. W. Loyd

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Guillaume de Chalmot,

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

(No Model.) 2 Sheets—Sheet 2.

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ELECTRIC FURNACE.

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FIG. 2.

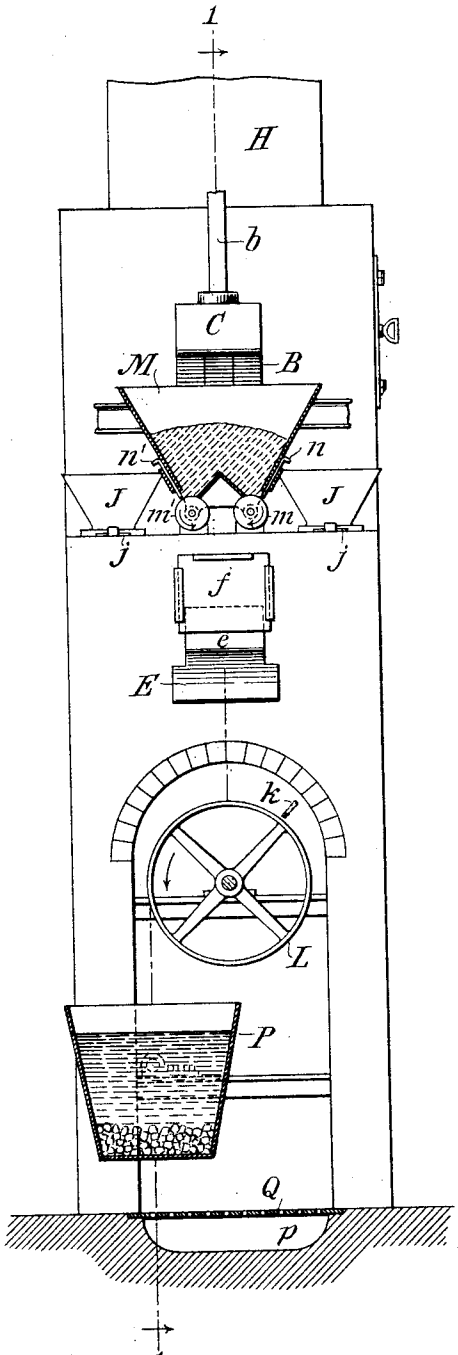
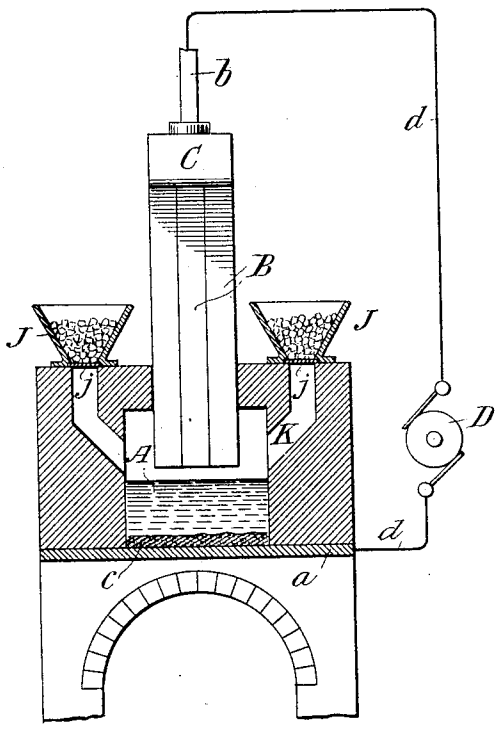


FIG. 3.



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UNITED STATES PATENT OFFICE.

GUILLAUME DE CHALMOT, OF LEAKSVILLE, NORTH CAROLINA, ASSIGNOR TO THE WILLSON LABORATORY COMPANY, OF NEW YORK, N. Y.

ELECTRIC FURNACE.

SPECIFICATION forming part of Letters Patent No. 588,267, dated August 17, 1897.

Application filed December 24, 1895. Serial No. 573,214. (No model.)

To all whom it may concern:

Be it known that I, GUILLAUME DE CHALMOT, a subject of the Queen of the Netherlands, (having declared my intention of becoming a citizen of the United States,) residing in Leaksville, in the county of Rockingham and State of North Carolina, have invented certain new and useful Improvements in Electric Furnaces, of which the following is a specification.

This invention relates to furnaces for electric treatment of materials, such as the fusing thereof or the smelting or reduction thereof. It is applicable to various metallurgical reductions and other metallurgical processes, such as the fusing together of refractory metals to form alloys. It is in part applicable to electric reductions, such as the reduction of lime with carbon to form calcium carbid. In all its features, however, my improved furnace is especially adapted and designed for the treatment of substances which on the one hand give off fumes or gaseous constituents under the high heat of the electric furnace, which constituents it is desirable to recover, and which on the other hand it is desirable to discharge as quickly as possible from the furnace in order to avoid an excessive reducing action or other excessive effect due to the high temperature. To the latter end my furnace is designed so as to permit the material under treatment to overflow from the top of the furnace as soon as it becomes molten.

The preferred form of my improved furnace is shown in the accompanying drawings, wherein—

Figure 1 is a vertical mid-section. Fig. 2 is a front elevation, partly in vertical section, on the line 2 2 in Fig. 1. Fig. 3 is a vertical transverse section on the line 3 3 in Fig. 1.

Referring to the drawings, let A designate the hollow hearth or crucible of the furnace, and B the carbon pencil thereof. The hearth A has a bottom layer of carbon *c*, and beneath this a conducting-plate *a*, preferably of iron, through which the current may enter or leave the furnace. The walls of the furnace-hearth may be made of fire-brick or other refractory material and may be lined or not with carbon.

The carbon pencil B is a massive block or slab of carbon and is adjustable up and down through a suitable hole in the roof or crown of the furnace. It is best constructed by being built up of slabs of carbon (or of square bars, if preferred) held in a holder or clamp C, carried by a vertically-adjustable rod *b*, hung from suitable adjusting mechanism. (Not shown.)

As shown in Fig. 3, the iron plate *a* and the carbon-holder C are respectively connected by suitable conductors *d d* with the opposite terminals of a dynamo D, or in case alternating currents are used with the terminals of a transformer, if preferred.

The furnace has at its front an overflow-opening *e*, through which the molten material may overflow from the furnace over the front wall E. The opening *e* may be more or less closed to obstruct ingress of air by lowering a slide or door *f*. From the furnace-chamber extends an outlet-flue F, which leads to a chamber G, in which are placed alternating trays *g g*, containing any suitable material for absorbing the fumes which pass out from the furnace through the flue F. From the chamber G the fumes enter the chimney H, which is of such height and construction as to afford a draft sufficient to carry off all fumes from the furnace-chamber. The draft may or may not be sufficient to draw air into the furnace through the opening *e*.

Instead of the chimney H any suitable draft or suction apparatus may be provided, as is well understood in furnace practice.

For some purposes it is desirable to admit air to the flue F in order to oxidize the fumes that pass off from the furnace. For this purpose I provide an air-inlet flue I, which may be controlled by any suitable door or damper I′, which may be more or less opened, the flue I communicating with the flue F through an opening or twyer *i*. A chain *i′* may be provided for enabling the door I′ to be retained in any position. The flue I preferably traverses the flue F for a sufficient distance to somewhat heat the entering air.

For enabling the material under treatment to be fed to the furnace hoppers J J are provided, as shown in Fig. 3, arranged on opposite sides of the carbon pencil, from the bot-

toms of which hoppers the flues K K lead downward and discharge obliquely into the furnace-chamber on opposite sides of the carbon pencil. These flues are controlled by slides *j j*.

Beneath the overflow-wall E is arranged a hollow cylinder L, preferably of iron plate, onto which may fall any material which overflows from the furnace.

For preventing the molten material adhering or caking to the cylinder I provide means for sprinkling sand or other equivalent material upon the cylinder, so as to protect the latter by a layer of this material applied to it before the molten material can reach it. To this end I provide above the cylinder a hopper M for containing the sand or other substance. This hopper has some suitable means for feeding out the sand so that it may fall on the cylinder. I have shown a double hopper with two feed-rollers *m m'* and slides *n n'* for controlling the flow. The rollers revolve in opposite directions, so that they feed the sand out from opposite sides. The sand fed out by the roller *m* falls on the ascending side of the cylinder, a plate *k* being arranged to keep it from dropping off or sliding down the side of the cylinder. Hence the revolving cylinder receives from this feed-roller a sprinkling of sand, forming a layer of suitable depth. The roller *m'* is arranged to feed another sprinkling of sand upon the opposite or descending side of the cylinder, so that this portion of sand falls upon the cylinder after the latter has received the molten material from the furnace.

Beneath the descending side of the cylinder is a tank P, which may contain water, sand, or other substance, which is hung upon trunnions, so that it may be overturned. Into this tank the material falls as the cylinder revolves. Beneath the tank is a grating Q, and below the grating is a gutter *p* for carrying off water, so that when the tank P is inverted the solid material will fall upon the grating and the water will run off beneath.

The improved furnace thus described has been designed especially for the treatment of natural phosphates or phosphate-rock by processes which are claimed in two other applications which I have prepared. I will describe the operation of the furnace in connection with the treatment of phosphate-rock according to these processes.

The rock is ground or broken up and mixed or not with sand and is then placed in the hoppers J J. In starting the operation the carbon pencil B is lowered to the hearth-lining *c*, and by opening the slides *j j* some of the ground material is dumped into the furnace-chamber on each side of the carbon pencil, the electric current is started, and the pencil is slightly lifted to form an arc, the heat of which fuses the phosphate, and the pencil is gradually lifted, while more material is continually fed in until a pool of molten phosphate is accumulated in the furnace as high as the wall E. The operation is now fully started and may be carried on continuously. It is only necessary to gradually supply the material from the hoppers and keep the carbon pencil adjusted so as to maintain the arc properly, the supply of material being graduated so that it will displace the phosphate about as fast as the latter becomes molten, thereby causing the molten phosphate to continuously flow out over the wall E and fall upon the cylinder L, which has previously received its surface coating of sand from the hopper M. As the cylinder revolves the phosphate is carried of laterally, and a further layer of sand is then sprinkled over it from the feed-roller *m'* of the hopper. The phosphate hardens upon the cylinder, and as the latter turns it is dumped, while still very hot, into the water in the tank P, whereby it is quickly cooled. When most of the water has been evaporated, the tank P is inverted to dump the phosphate out upon the grating Q.

The fumes from the furnace are drawn off through the flue F and circulated over the trays *g g* in the chamber G, which trays are filled with moistened calcareous material, preferably crushed phosphate-rock or lime, or other material adapted to take up the anhydrous phosphoric acid; or water may be placed in the trays *g*, or the fumes may otherwise be drawn into contact with the water, whereby the anhydrous phosphoric acid is converted into metaphosphoric acid.

The principal feature of my invention is found in the construction of the furnace, whereby the molten material is permitted to flow out as fast as it becomes molten. While an arc furnace is preferred, yet other forms of electric furnace may be applied in connection with my invention, such modifications and modes of applying electrically-generated heat in a furnace being well understood by those familiar with electric smelting apparatus. The molten material might be dropped directly into the tank P; but it is preferable in case of phosphate to receive it upon a layer of sand, and this I consider most practically effected by employing the cylinder L, which not only forms a bed for the sand and for receiving the molten phosphate, but also automatically and continuously dumps the latter. A revolving table or disk might be substituted for the cylinder L, with means for dumping the material by pushing it off therefrom.

If desired, the furnace might be entirely inclosed in a casing or shell, of metal or other material, in order to prevent access of air to it; or in some cases it may be sufficient by a suitable adjustment of the slide *f* to inclose the carbon pencil B in a vertical casing or chamber such as is shown in dotted lines at R in Fig. 1, this chamber being of such height as to permit the pencil B to be raised to its highest position and being provided with a hole in its top through which the rod *p* may

move. The top of the chamber R should be removable in order that the pencil B may be lifted out bodily while replacing the carbon slabs or pencils.

The furnace-wall E may require renewing occasionally, and to this end another feature of my invention consists in constructing this wall of the material under treatment or resulting from the treatment in the furnace and in renewing the wall by building it up by the solidification of this material. In a furnace for treating phosphate-rock I make this wall of such rock. In a furnace for producing calcium carbid I make the wall of this carbid. In any case it is made of the fused material in the furnace, being arranged sufficiently far from the arc or source of electrically-disengaged heat as to be protected from fusion thereby during the ordinary operation of the furnace. By increasing the heat in the furnace this wall can be partly melted away and thereby lowered, so as to increase the outflow of molten material from the furnace. By then reducing the heat the wall will cool and the molten material in the furnace will congeal against it, thereby building it up or renewing it and at the same time raising its level, and hence checking the outflow of the molten material. My invention thus affords a ready means not only for renewing the structure of the overflow-wall from time to time, but for regulating the operation of the furnace by simply varying the heat which is maintained within it, this being accomplished by the control of the electric current and by varying the arc in the manner well known to operators of electric furnaces. The construction of the wall of the fused material in the furnace prevents any contamination of the product such as might occur if the wall were of other material by the fusing of the latter into the bath of fused material in the furnace.

The chamber G may be replaced by any other suitable absorption apparatus.

The roller *m'* or other means for feeding sand or other powder may drop it on the cylinder at the same time that the molten material falls upon it from the furnace instead of subsequently.

The cylinder L or its substitute may be made hollow, so as to cool by radiation, or it may be cooled by currents of air or by a circulation of water (as by playing a hose on it) or otherwise, such means of cooling apparatus that is exposed to high heat being well known.

I claim as my invention the following-defined novel features, substantially as hereinbefore specified, namely:

1. An electric furnace constructed with an overflow-opening, combined with a revolving part arranged beneath it to receive the overflowing material, and means for sprinkling a layer of subdivided material upon said part in advance of the falling upon it of the material overflowing from the furnace.

2. An electric furnace having an overflow-opening, combined with a revolving part arranged beneath said overflow-opening, means for sprinkling sand or comminuted material on said part in advance of its receiving said overflow, and means for sprinkling a comminuted material upon the same subsequent to its receiving said overflow.

3. The combination of an electric furnace having an overflow-opening, a cylinder L arranged beneath said opening to receive the overflowing material, a sand-hopper M having a delivery-roller, and means for revolving said cylinder and roller, whereby to sprinkle sand upon the cylinder.

4. An electric furnace constructed with an overflow-opening, combined with a revolving cylinder beneath said opening, and a sand-hopper M above the cylinder constructed with two discharge-spouts arranged to discharge streams of sand onto the cylinder on opposite sides of the stream of material flowing from the furnace.

5. An electric furnace constructed with a hollow hearth or chamber closed on all sides, having a carbon bottom, said chamber formed with an opening through its roof, and with an overflow-opening at a level considerably above said carbon bottom, a carbon pencil adjustable vertically through said opening in the roof, a slide movable to more or less close said overflow-opening, a flue leading from said chamber, and a chimney or suction device for drawing the fumes from the furnace-chamber through said flue.

6. The described method of renewing the overflow-wall of an electric furnace consisting in increasing the heat in the furnace so as to partially fuse down said wall, then supplying like fused material in the furnace and reducing the heat sufficiently to cause such material to congeal against the wall and thereby build up the latter, substantially in the manner specified.

7. The described method of controlling the discharge of molten material from an electric furnace having an overflow-wall of the same material, which consists in increasing the heat within the furnace sufficiently to partly fuse down said wall and thereby lower its level, so that the fused material runs out down to such reduced level, and then reducing the heat and supplying additional material which becomes molten until by the congealing of such molten material against and upon said wall the latter is restored and the level of the fused material in the furnace is raised, substantially as specified.

In witness whereof I have hereunto signed my name in the presence of two subscribing witnesses.

G. DE CHALMOT.

Witnesses:
J. M. HOPPER,
S. P. JARRETT.