No. 628,373. Patented July 4, 1899.

F. P. VAN DENBERGH.

ELECTRIC FURNACE.

(Application filed Jan. 15, 1896.)

(No Model.) 2 Sheets—Sheet I.

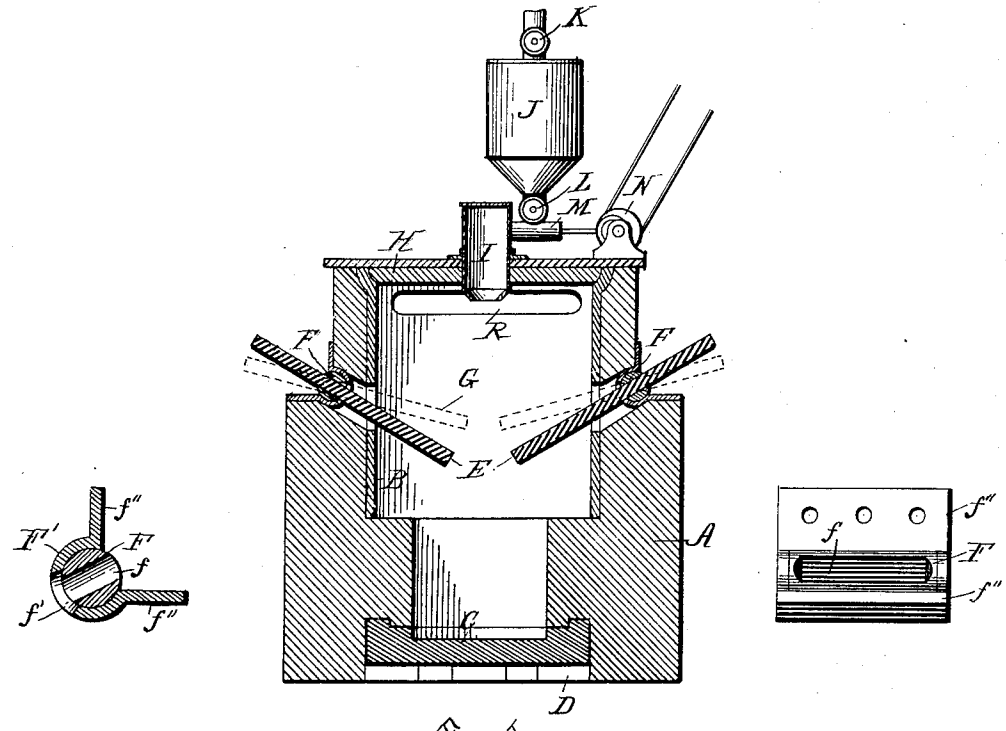


Fig. I.

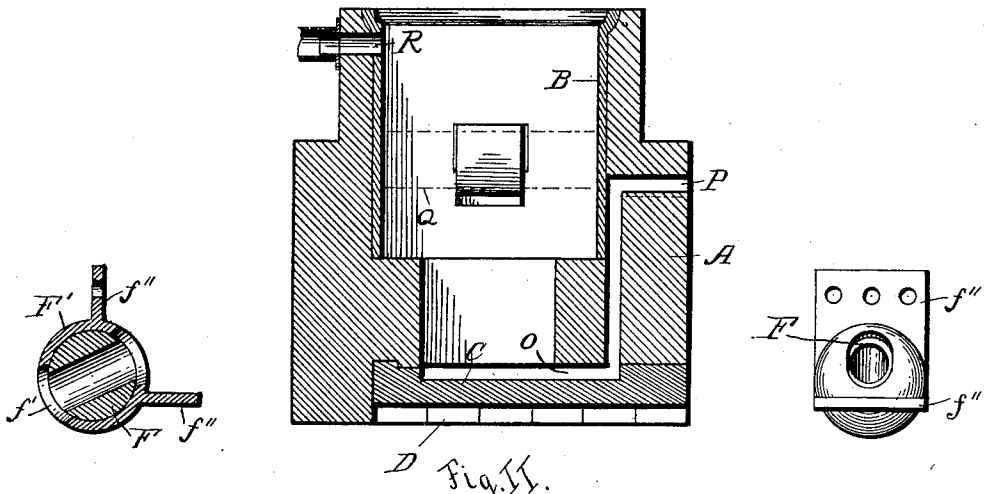


Fig. II.

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Inventor:
Frank P. Vandenbergh
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THE NORRIS PETERS CO., PHOTO-LITHO., WASHINGTON, D. C.

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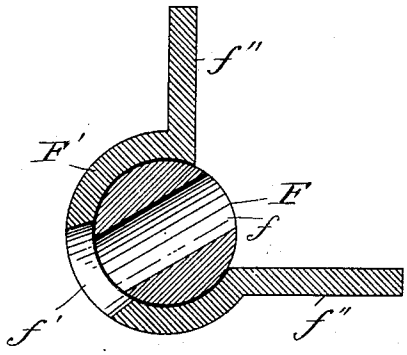


Fig. III.

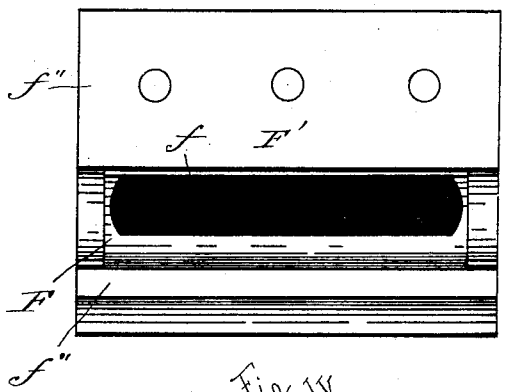


Fig. IV.

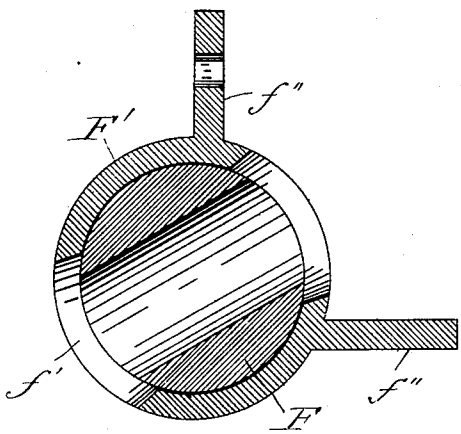


Fig. V.

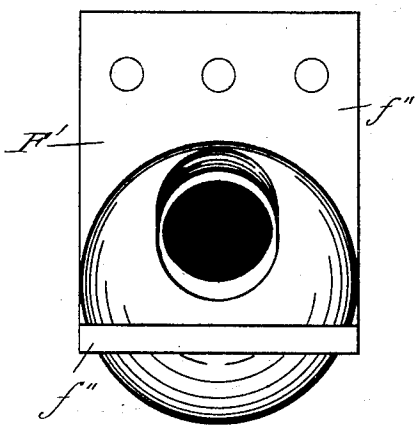


Fig. VI.

Witnesses:
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Temple Bodley

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Frank P. Van Denbergh
By his Attorneys:
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THE NORRIS PETERS CO., PHOTO-LITHO., WASHINGTON, D. C.

UNITED STATES PATENT OFFICE.

FRANK P. VAN DENBERGH, OF BUFFALO, NEW YORK.

ELECTRIC FURNACE.

SPECIFICATION forming part of Letters Patent No. 628,373, dated July 4, 1899.

Application filed January 15, 1896. Serial No. 575,626. (No model.)

To all whom it may concern:

Be it known that I, FRANK P. VAN DENBERGH, a citizen of the United States, residing at Buffalo, in the county of Erie and State of New York, have invented a new and useful Improvement in Electric Furnaces, of which the following is a full, clear, and exact description.

My invention relates to an improvement in electric furnaces, and more particularly to a furnace for the purpose of reducing ores and other materials.

The object of my invention is to employ heat produced by electric energy in direct contact with the material and to provide means whereby heat so produced may be rendered efficient in the continuous and economical decomposition of a wide range of minerals and other substances, particularly those of a highly-refractory nature. In order that such end may be attained, I provide a furnace simple, cheap, and readily repaired, means for regulating the length of the arc and also means for adjusting the position of the arc with reference to the material or charge within the furnace, a system of continuous feed capable of accurate regulation, means for carrying the gases and vapors to a condenser, and means for regulating and maintaining a uniform level of the liquefied mass in the furnace and a continuous removal of the same while the furnace is in operation, and means for maintaining a substantially uniform and constant thermal action for the purpose of securing a complete and exhaustive reduction.

As stated, my invention is adapted to use in a wide range of reduction processes. Typical processes would be such as the production of phosphoric acid from apatite or other phosphoric substances, the production of sulfuric acid from gypsum or other material containing sulfur or its compounds or the reduction of cinnabar ores, or the reduction of such materials as the alkaline chlorids and bromids, and I do not limit myself to any one process or the production of any one product. For this reason the drawings herewith are diagrammatic in character, leaving it to the person skilled in the art to adapt, through mechanical skill, the general principles to the specific use in hand.

Referring to the drawings herewith, in which like letters refer to like parts throughout the drawings, Figure 1 is a longitudinal vertical section, and Fig. 2 a transverse vertical section, of my invention. Fig. 3 is a detail cross-sectional view, enlarged, of a holder for a flat electrode. Fig. 4 is an inside elevation of the same. Figs. 5 and 6 are views similar to Figs. 3 and 4, illustrating another form of electrode-holder.

A is the main body of the furnace, which may be made in any desired form and of any desirable heat-resisting material. Preferably this body should be built up of a fireclay or other refractory material thoroughly luted, and it is desirable at times to line the upper portion of the chamber with a heat-resistant, as shown at B, to further prevent the escape of gas or vapor. It is also desirable that the lower crucible portion of the chamber should be somewhat reduced in cross-section in order that a less quantity of liquefied material may be retained without reducing the depth of the crucible. The base of the crucible C should be readily removable, and in the drawings I have indicated one simple method—that of having the base C flanged, so as to engage closely with the body A, and blocking the same in place with brick D D.

E E are electrodes connecting, respectively, with the positive and negative poles of a source of electric energy. These electrodes should be mounted slidably within bearings F, so that they may be inserted or withdrawn to regulate the length of the arc, and they should also be mounted so that the inner ends may be raised or lowered with reference to the mass within the chamber independent of the axial or endwise movement of the electrodes. The bearings F, in which the electrodes are mounted, are close-fitting, so that the vapors within the furnace shall not escape at such places, and they are preferably round in cross-section and so mounted that they may turn with the electrodes as the latter are moved. The dotted lines G, Fig. 1, indicate positions to which the electrodes may be moved.

The bearings F for the electrodes are constructed of iron or other suitable metal and are round in cross-section and perforated for

the passage of the electrodes, as at *f*. These bearings will be properly insulated, as by means of sheets or plates of mica, and are mounted in supporting boxes or brackets F', in which the bearings fit with sufficient tightness to prevent the escape of the vapors formed within the furnace and yet allow the bearings to be turned to change the positions of the electrodes. The boxes or brackets F' are secured to the refractory walls of the furnace, being provided with flanges *f''* for that purpose, in such positions that they and the bearings F are not subjected directly to the intense heat generated within the furnace-chamber, the furnace-walls being perforated, as at *a*, to permit the passage of the electrodes from their bearings into the furnace-chamber.

In Figs. 3 and 4 there is illustrated a holder or bearing for a broad flat electrode and in Figs. 5 and 6 a bearing for a round electrode. The bearing F (shown in Figs. 3 and 4) is cylindrical in shape and can only turn on its longitudinal axis, so the electrode is adjustable only in the arc of a circle, except as it is adjustable in the direction of its length by being slid bodily within its bearing. The bearing shown in Figs. 5 and 6 is globular in shape, so that the electrode which it carries may be adjusted in any direction.

The top of the chamber may be closed in any desired manner, but a movable cap H, as shown, is preferable. Through this top is an inlet I, through which the material to be treated, properly combined with a flux or such other agent or agents as may be required, is introduced. The material is fed into the inlet from a feed-reservoir J, closed at the top and bottom by valves K and L, by any one of the well-known feed mechanisms, such as the cylinder and piston M, as shown, actuated by an eccentric and pulley N, belted to a source of power providing a regulatable feed.

The feeding device just described and which is illustrated in the drawings operates to seal the furnace-chamber against the escape of gases at this place by reason of the packing of the material being fed in the cylinder M. It will be observed that the feeding device is arranged directly above the electrodes, so that the material as it is fed into the chamber of the furnace falls directly into the electric arc between the electrodes.

The feed-reservoir should connect, through the valve K, with a storage-reservoir which contains the supply, and by closing the valve L and opening the valve K the feed-reservoir may be filled without any backing up of fumes or gases.

R is an outlet-pipe connecting with a condensing-chamber constructed to meet the needs of the process in use.

O is an opening leading from the base of the crucible and passing upward within the body of the furnace A and then to an exit P. It is evident that the height of this exit will determine the level of the liquid mass within the crucible, as indicated by the broken line Q, and it is clear to one skilled in the art that this exit may be readily changed to meet the demands of the process. It is advisable that this means of egress for the liquid mass should lead from the bottom, so as to remove the material which has been most effectively treated, and it is particularly important that the conduit to the exit P should be adjacent (as in the construction shown) to the furnace-chamber in order that the heat from the body of the furnace may insure perfect liquefaction and consequent free flow of the material being drawn off.

The electrodes enter the furnace-chamber at a height above the level at which the mass of liquefied material being treated stands, so that the arc between the electrodes is above the liquid mass. This is most important, because if the electrodes are within the fluid mass the working value of the electric arc will be so impaired by reduced resistance in the mass that practically no result on refractory substances would be obtained.

The residuum-exit is free, so that the discharge may be continuous, and its opening O into the crucible is situated at a level much below the point where the electric arc is most active, so that the material is thoroughly reduced before it passes out of the crucible. Were the electrodes situated within the fluid mass, especially were one or both of them below the level of the residuum-exit, danger and loss would arise when the process was working continuously from the passage of gases along with the residuum. This I avoid by the construction and arrangement of the parts of the furnace as described.

In operation the furnace is charged, the electrodes raised and brought near together, the current applied, and the product slowly fed in. As the resistance of the mass reduces with fusion the electrodes should be retracted, and as the fusion increases depressed to the most effective point of operation. The gases or vapors fill the chambers and are forced out through the outlet-pipe R to the condenser. The feed becomes continuous, rapid, and complete, and the liquefied mass rises to the level G, and it is continuously carried off through the opening and exit O, and thus the process becomes continuous and for all practical purposes self-regulating.

Having thus described my invention, what I claim is, without limiting myself to the specific mechanism shown—

1. An electric furnace, comprising a feeding device, electrodes, adjustable lengthwise with reference to each other to vary the length of the arc, and also provided with means whereby the inner ends of the electrodes are vertically movable, independent of the said lengthwise adjustment, to change the position of the arc with reference to the mass of material being treated, a vapor-exit and a residuum-exit, substantially as set forth.

2. In an electric furnace, a close furnace-chamber having a vapor-exit, a crucible hav-

ing a free residuum-exit leading from its lower portion and discharging at a higher level than the crucible, a continuous-feed mechanism, and electrodes adjustable lengthwise with reference to each other to vary the length of the arc, and also adjustable vertically, at their inner ends, independent of the said lengthwise adjustment, substantially as set forth.

3. In an electric furnace, the combination with the body of the furnace having refractory walls, of the electrodes which extend through the walls of the furnace into the furnace-chamber, the electrodes being adjustable toward and from each other in the direction of their length, and also adjustable so that the inner ends of the electrodes may be raised or lowered with reference to the mass within the furnace without at the same time adjusting them in the direction of their length, substantially as set forth.

4. An electric furnace comprising the following elements: viz., the electrodes, adjustable in the direction of their length, and also vertically adjustable within the furnace-chamber independent of their adjustment in the direction of their length, an automatic, regulatable feeding mechanism, a vapor-exit, and a residuum-exit leading from the lower part of the furnace-chamber, and discharging at the level which it is desired the fluid mass within the furnace should maintain, substantially as set forth.

5. In an electric furnace, the combination with the body of a furnace having refractory walls, of the electrodes, and the bearings for the electrodes, each round in a cross-section, taken on a line corresponding with the longitudinal center of the electrode, and mounted within the walls of the furnace so as to be free to turn therein to a limited extent, substantially as set forth.

In testimony that I claim the invention above set forth I affix my signature in presence of two witnesses.

FRANK P. VAN DENBERGH.

Witnesses:
EDWARD R. BOSBY,
CHARLES M. HUGHSON.