June 3, 1924. 1,496,231

B. G. KLUGH

ELECTRIC SMELTING FURNACE CONSTRUCTION

Filed March 23, 1922

Fig. 1

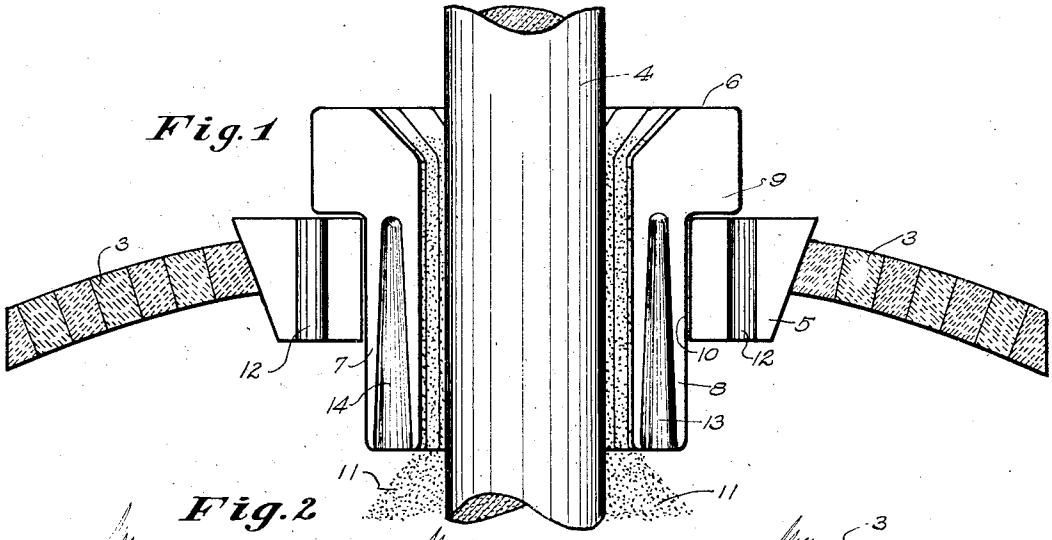


Fig. 2

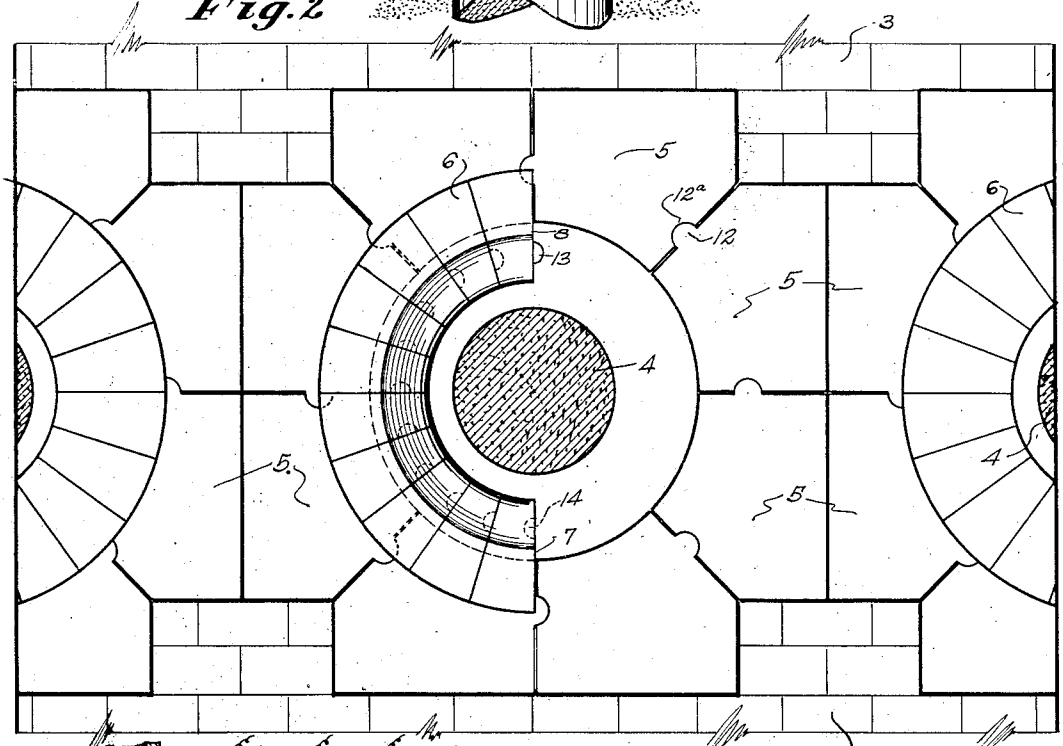


Fig. 3

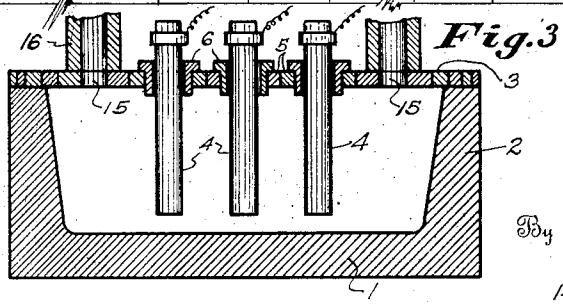
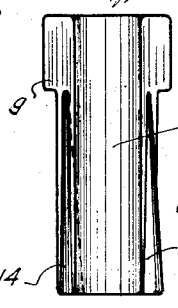


Fig. 4



Inventor
B. G. Klugh.

By

Attorney

Patented June 3, 1924. 1,496,231

UNITED STATES PATENT OFFICE.

BETHUNE G. KLUGH, OF CHICAGO, ILLINOIS, ASSIGNOR TO FEDERAL PHOSPHORUS COMPANY, OF BIRMINGHAM, ALABAMA, A CORPORATION OF ALABAMA.

ELECTRIC-SMELTING-FURNACE CONSTRUCTION.

Application filed March 23, 1922. Serial No. 546,173.

To all whom it may concern:

Be it known that I, BETHUNE G. KLUGH, a citizen of the United States of America, residing at Chicago, in the county of Cook and State of Illinois, have invented certain new and useful Improvements in Electric-Smelting-Furnace Constructions, of which the following is a specification.

My invention relates to an electric smelting furnace especially adapted to the smelting of natural phosphates, but available for the smelting of other materials.

More particularly my invention is an improvement on the electric furnace design forming the subject matter of my pending application, Serial No. 387,807, filed June 10, 1920, in which I disclose an electric furnace especially designed for the smelting of natural phosphates with a silicious flux and a carbon reducing agent, the furnace being designed throughout from refractory material and provided with an enclosing roof having one or more openings each adapted for the passage therethrough of a vertically suspended electrode of such diameter as to leave ample clearance around it for the feeding of stock to the furnace about the electrode in such manner as to utilize such entering stock both to seal the clearance about the electrode, thereby preventing the escape of objectionable gases and fumes from the furnace, and to utilize the inflowing stock to protect the electrode from the injurious action of the burning gases. This double function was accomplished by the incorporation in the roof of what I term a stock feed ring or conduit which, in its preferred form, was of a refractory character, and was built into and formed an integral part of the roof. This stock feed ring was designed to depend into the furnace to a sufficient depth to maintain above the stock in the furnace an ample space for the reception and combustion of the evolved gases before they passed off through the eduction port or ports in the furnace. Moreover, in the operation on a commercial scale of electric smelting furnaces designed in accordance with my invention aforesaid, it was found preferable to utilize a single arched roof free of metal girders or beam supporting members and having the stock feed ring or rings forming part of the key members of the arch. While this construction is entirely practical and suitable for many purposes, it is obvious that such key elements cannot be removed and replaced without serious disturbance of the roof, and one object of my present invention is to devise a practical furnace design which will permit of the ready removal and replacement of these stock feed conduits which is often necessary, both because of wear from the stock and of injury from high furnace heat, due to their dependance into the furnace. In practice, their life is not as long as the life of the ordinary refractory roof bricks and hence economical operation indicates the necessity of providing means for their ready replacement with a minimum of cost and disturbance to plant operation. In the smelting of certain products in an electric furnace, and particularly in the smelting of phosphatic material wherein it is desired to oxidize the evolved phosphates within an enclosed furnace, I have found it important to maintain as large a gas chamber or combustion space above the stock as possible. Inasmuch as it is impractical to expose the electrode to the burning gases this necessitates the use of stock conduits which project very deeply into the furnace. Obviously the deeper that the stock feed conduit projects into the furnace the more rapid its deterioration and the more important the provision in the furnace design for its ready and inexpensive replacement without distubrance of the roof. From the point of design and also with the idea of preserving the entire gas combustion space intercommunicative throughout the furnace, it is desirable to avoid any longitudinal or transverse braces or supports for the roof and I therefore prefer to adhere to the simple arched type of roof, the load and thrust of which is supported wholly by the marginal furnace walls and the external metallic bracing members.

A further object of my invention is to form the stock feed conduit with a series of elongated refractory bricks, preferably having interlocking members which are wedge shaped and so disposed that notwithstanding a transverse fracture of any of such bricks the fragments will remain suspended in the roof by the wedge interlock means and cannot fall from place into the furnace.

My invention further comprises the novel details of construction and arrangements of parts, which are hereinafter more fully de-

scribed and claimed, and which are illustrated in their preferred embodiment only in the accompanying drawings, in which:—

Fig. 1 is a vertical transverse cross section through the roof of an electrical smelting furnace as designed for phosphatic smelting, the view being broken away to show the arch key ring and stock feed conduit in vertical cross section, the view showing reverse side faces in elevation of the opposite bricks of the conduit.

Fig. 2 is a plan view of a portion of the furnace roof showing the arch key ring built into the roof and the stock feed conduit seated therein, some of the conduit bricks being removed to show part of the blocks forming the arch key ring in plan.

Fig. 3 is a longitudinal cross-sectional view on a reduced scale of a smelting furnace having the top of its arch formed by a series of arch key rings for the stock feed conduits and for the gas eduction flues.

Fig. 4 is a detail view of the brick or block used to form the removable stock feed conduit, viewed in elevation from its inner or tapered edge.

Similar reference numerals refer to similar parts throughout the drawings.

As illustrated, I show an electrical furnace having a hearth 1, marginal walls 2 and a roof 3 which is arched from side to side and which in the preferred practice is built up of a series of standard refractory arched brick. I show the furnace as provided with three electrodes 4, though any desired number may be utilized. These electrodes are intended to be suspended vertically by any suitable mechanism (not shown), and to pass through openings in the roof. These openings are formed according to my present invention as follows. I build into the furnace roof to form each opening a series of special blocks 5 which are adapted to form, when set, a circular opening. These blocks being preferably of greater depth than the standard roof brick will project below the ordinary roof brick sufficiently to enable these special blocks to function as a portion of the arch key. These blocks are provided with upper flat faces and thus provide a flat seat surrounding the opening. The opening thus formed by the permanently incorporated roof blocks 5 is sufficiently large to receive my improved type of stock feed conduit or stock feed ring. This stock feed conduit is formed by a series of special refractory bricks 6 which have their side walls 7 and 8 tapered to lie in radial planes from the center of the stock feed opening. At the upper end of each block I provide an outwardly overhung shoulder or lug 9 which has a flat underface adapted to rest upon the flat upper face of the supporting arch key ring. Below this shoulder the outer face 10 of each brick 6 stands vertical and is curved to conform to the circular wall of the ring opening against which it rests. The lower ends of the bricks project downwardly into the furface to the desired extent according to the design and contemplated use of the furnace within the practical limits of the tensile strength of the brick. I prefer that these bricks should be supported entirely by the engagement of their lugs 9 on the supporting arch key ring, thus leaving them entirely free of any lateral or radial compression strains, and relieving the stock feed conduit of all strains except the suspension strain of its own load, which is limited only by its tensile strength, and except the practically negligible outward thrust of the thin annulus of stock 11 passing between it and the electrode 12.

The side faces 7 and 8 of the blocks 6 are provided with complementary tongue and groove members which extend from the bottom edges of the blocks upwardly to a point near their upper ends. The tongue member 13 tapers vertically from its base both in width and thickness and tapers outwardly in horizontal cross-section from the side face of the block. Preferably its outer edge is rounded. The groove 14 is tapered in a manner complementary to the tapering wedge shape described for the tongue member, and when the bricks are assembled to form the conduit with the tongue and groove members interlocked it will be at once apparent that the upwardly tapering wedge tongues will prevent the dropping down into the furnace of any broken pieces of any contiguous brick. Moreover, this tongue and groove interlock of the depending lower ends of the brick serves to tie them together so as to resist any slight outward pressure from the stock. In other words, any pressure exerted on any individual block is transmitted to the other in the series, and the thrust is thus distributed.

It will be observed that I have succeeded in constructing the furnace with a substantially continuous refractory wall and roof, avoiding any internal projection or obstruction which would necessitate the employment of metallic bracing or supporting member, or which would interfere with the free circulation of the evolved gases throughout the entire chamber, or which would unduly increase the cost of construction of the furnace. Moreover I can utilize the simple arched construction of the roof and still maintain the stock level at a substantial distance below the roof without exposing the electrodes by the use of the deeply underhung stock feed conduit and the utilization of the stock descending therethrough to surround and protect the electrode.

As the stock feed conduit wears away or

becomes damaged or broken a replacement stock feed ring or conduit can be formed by assembling and clamping the annular series of bricks and same can be lowered into place after lifting out the worn or damaged conduit, this change being accomplished with a minimum interruption of furnace operation and without in the least disturbing the integral furnace roof or weakening it.

I utilize the assemblage or arrangement of the roof blocks 4 to form the outlet openings 15 for the gas mains 16 at either or both ends of the furnace and in this arrangement the sets of blocks 4 forming the several electrode and gas outlet openings will form a continuous longitudinal central or key portion for the arch which gives the roof greater strength and rigidity than is obtainable from the standard roof brick.

Though I have described with great particularity the details of the embodiment of the invention herein shown, it is not to be construed that I am limited thereto as changes in arrangement and substitution of equivalents may be made by those skilled in the art without departing from the invention as defined in the appended claims.

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

1. In an enclosed electric smelting furnace having in its roof a combined stock and electrode opening, and a removable stock feeding conduit mounted in and projecting through said opening.

2. In an enclosed electric smelting furnace having in its roof a combined stock and electrode opening, and a removable stock feeding conduit mounted free of compression strains in said opening.

3. In an enclosed electric smelting furnace having a stock feed opening in its roof, an elongated stock feed conduit removably supported on top of the roof and projecting through said opening substantially into the furnace.

4. In an enclosed electric smelting furnace, an arched roof formed of refractory material having an opening overhead formed by an arched key ring of built-in refractory bricks or blocks, in combination with an independent vertically elongated stock feed conduit adapted to seat on said ring and project downwardly through said opening into the furnace.

5. An enclosed electric smelting furnace in accordance with claim 4, in which the bricks or blocks forming the arch key ring have their upper surfaces flat and disposed in a horizontal plane, and the conduit is provided with an external shoulder resting on said ring.

6. In an enclosed electric smelting furnace having a stock feed opening in its roof, a vertically elongated stock feed conduit formed of assembled refractory segments and demountably seated on the roof with its lower end projecting through said opening into the furnace.

7. An enclosed electric smelting furnace in accordance with claim 6, in which the segments are provided in their abutting faces with interlocking tongue and groove elements.

8. An enclosed electric smelting furnace in accordance with claim 6, in which said segments are provided in their abutting side faces with interlocking tongue and groove members which taper upwardly.

9. An enclosed electric smelting furnace in accordance with claim 6, in which the segments are provided in their abutting side faces with interlocking vertically elongated tongue and groove members which taper upwardly both in their radial and circumferential dimensions.

10. An enclosed electric smelting furnace having an arched refractory brick roof, the central or key portion of the arch comprising relatively larger and deeper refractory blocks than the roof brick, and which are shaped and arranged to form, when assembled, a key ring, and a demountable stock feed conduit formed of assembled refractory segments which are elongated and shouldered at their upper ends to seat on said ring.

11. An enclosed electric smelting furnace having an arched refractory brick roof, the central or key portion of the arch comprising relatively larger and deeper refractory blocks than the roof brick and which are shaped to form, when assembled, a key ring, and a demountable stock feed conduit formed of assembled refractory segments which are elongated and shouldered at their upper ends to seat on said ring and project therethrough into the furnace, said segmental conduit being freely suspended from said ring.

12. An enclosed electric smelting furnace having an arched refractory roof, the central or key portion of the arch comprising refractory blocks relatively larger and deeper bricks than the roof and shaped to form, when assembled, a key ring, and a demountable stock feed conduit formed of assembled refractory segments which are elongated and shouldered at their upper ends to seat on said ring and project therethrough into the furnace, said segment conduit being freely suspended from said ring and its segments being free of rigid connection to each other or the key ring.

In testimony whereof I affix my signature.

BETHUNE G. KLUGH.

Witness:

NOMIE WELSH.