

G. DE CHALMOT.
ELECTRIC FURNACE.

(Application filed July 8, 1898.)

(No Model.)

4 Sheets—Sheet 1.

FIG. 1.

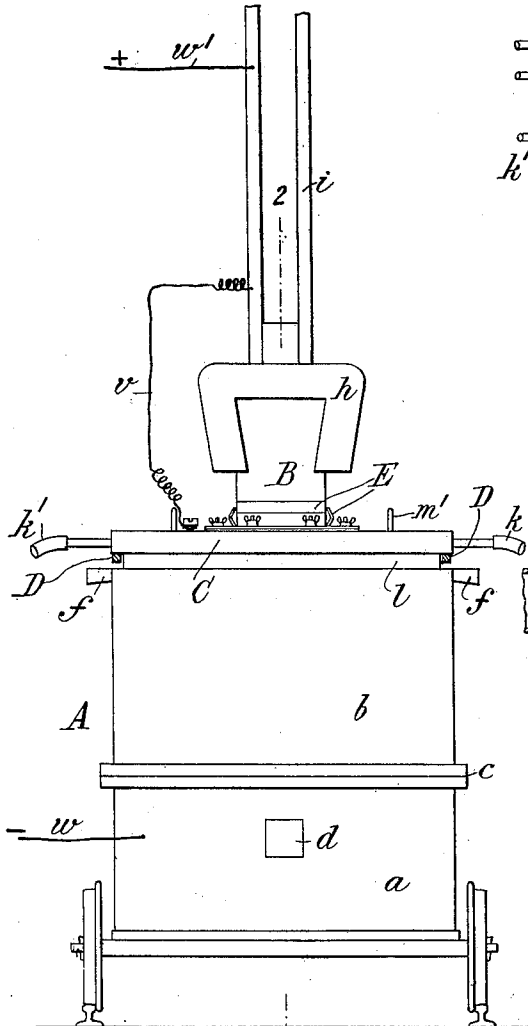


FIG. 2.

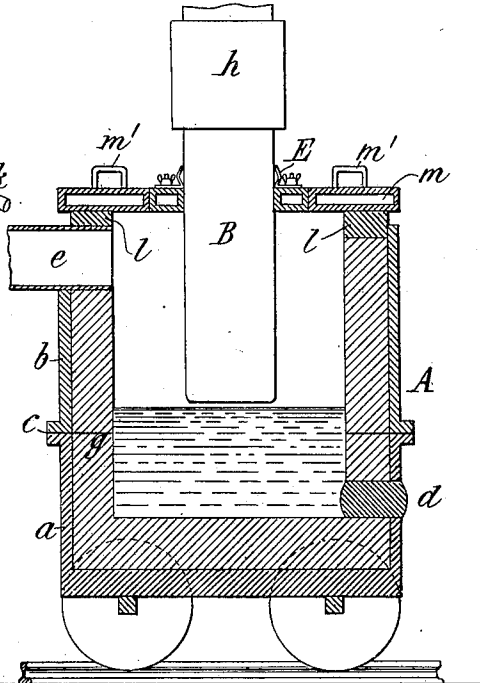


FIG. 3.

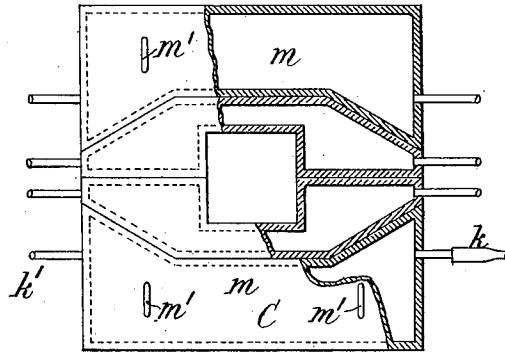
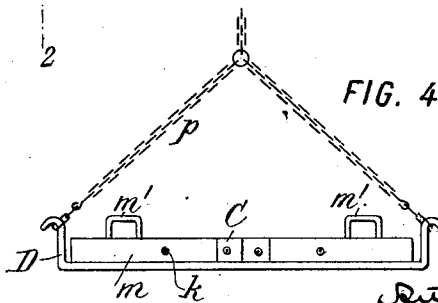


FIG. 4.



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FIG. 6.

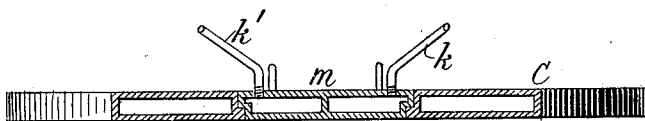
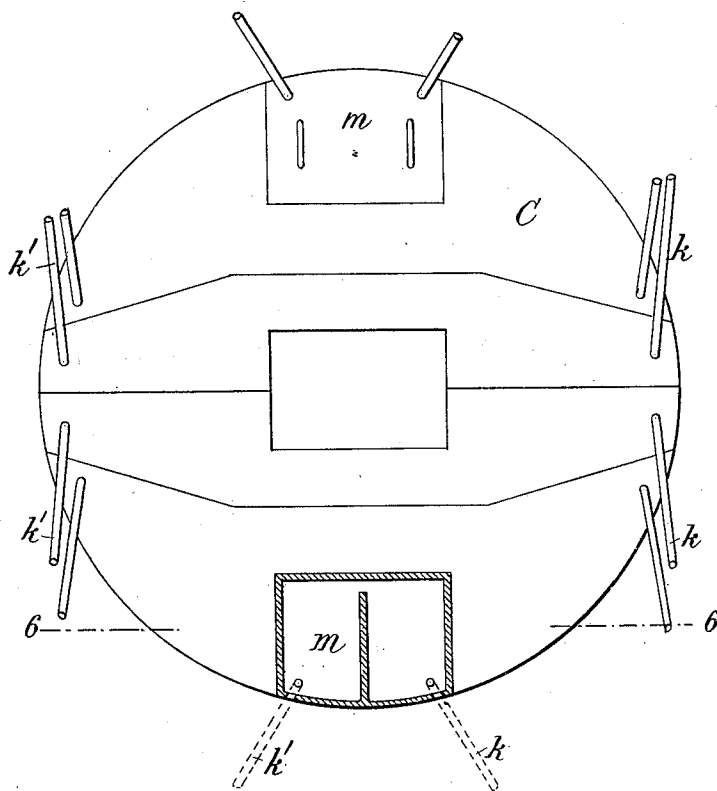


FIG. 5.



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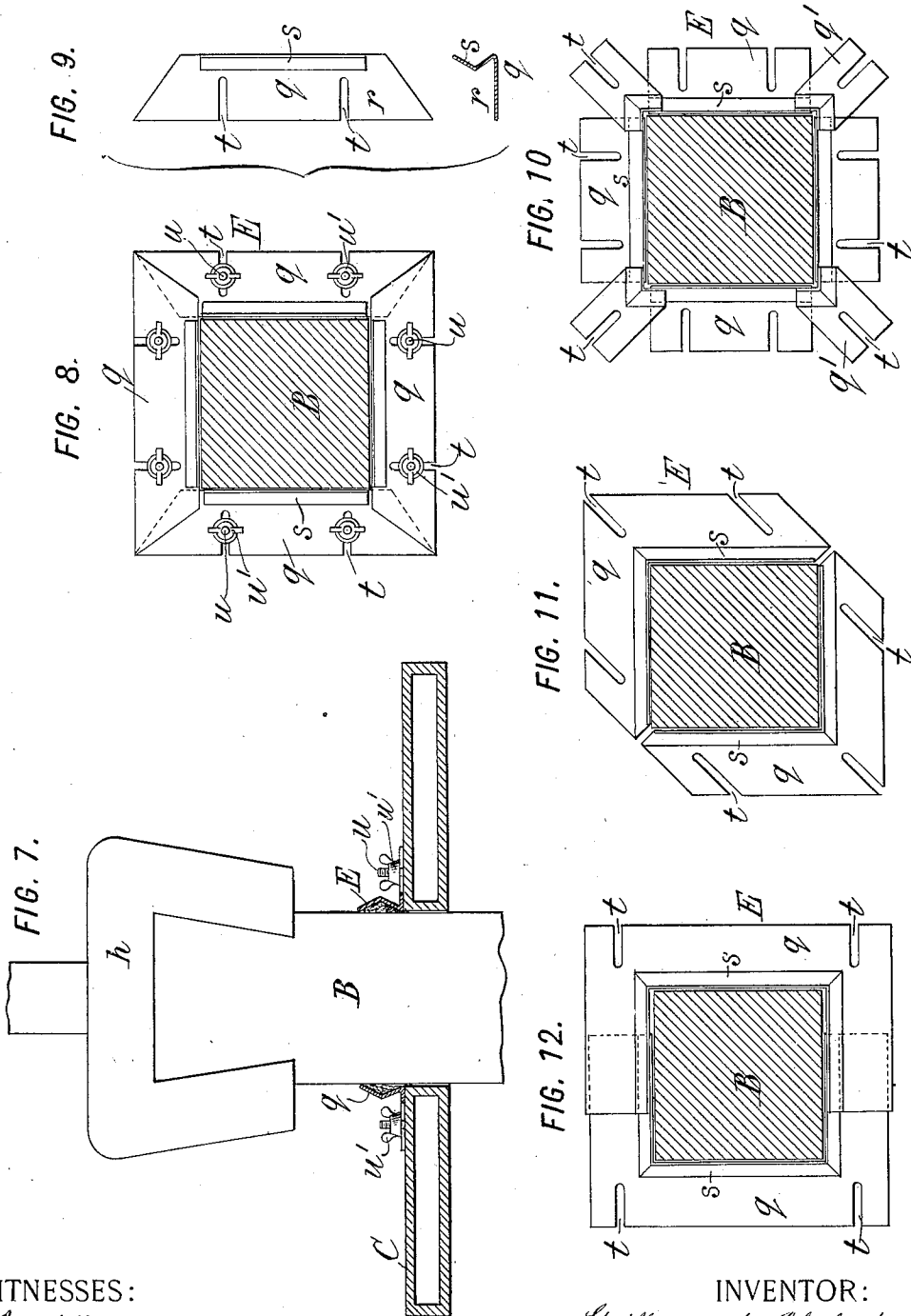
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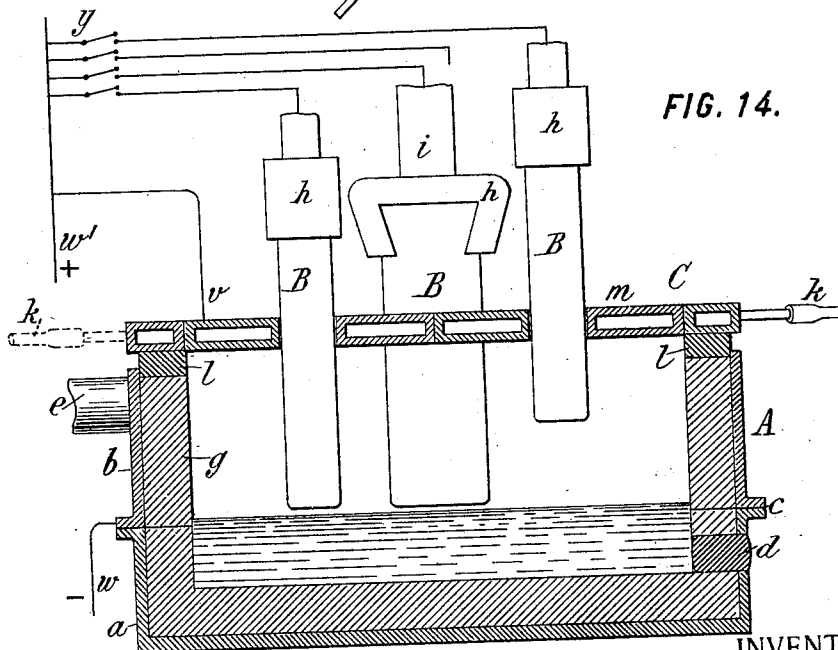
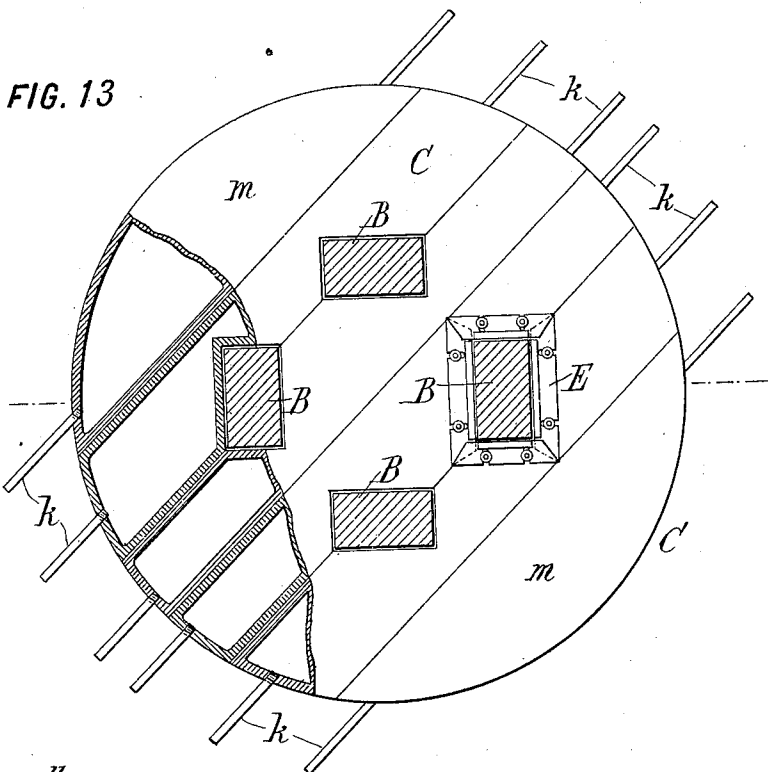
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G. DE CHALMOT.
ELECTRIC FURNACE.
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4 Sheets—Sheet 4.

(No Model.)



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UNITED STATES PATENT OFFICE.

GUILLAUME DE CHALMOT, OF HOLCOMBS ROCK, VIRGINIA, ASSIGNOR TO
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ELECTRIC FURNACE.

SPECIFICATION forming part of Letters Patent No. 699,654, dated May 13, 1902.

Application filed July 8, 1898. Serial No. 685,400. (No model.)

To all whom it may concern:

Be it known that I, GUILLAUME DE CHALMOT, a citizen of the United States, residing at Holcombs Rock, in the county of Bedford and State of Virginia, have invented certain new and useful Improvements in Electric Furnaces, of which the following is a specification.

This invention provides an electric furnace designed mainly for smelting metals or metalloids from their ores, but also useful for other electrometallurgical or reducing operations—for example, for the production of carbids or silicids. The furnace is of that class in which the furnace-pot, crucible, or hearth constitutes one of the electrodes, while the other is constituted by a pencil or bar of carbon (one or more) which enters the top of the furnace and is adjustable vertically therein.

My invention provides certain improvements in the construction of the furnace, designed principally to protect the carbon-pencil from wasting away by oxidation, to prevent the destruction of any portion of the furnace by formation of local arcs, and generally to facilitate the management of the furnace.

One feature of my invention provides a novel construction of stuffing-box for making a tight joint between the carbon electrode and the top or cover of the furnace for excluding

air. Figure 1 of the accompanying drawings is a front elevation of my improved furnace, of which Fig. 2 is a vertical transverse section on the line 2 2, and Fig. 3 is a plan, partly broken away, in horizontal section through the cover. Fig. 4 is a side view showing the means for lifting the cover. Fig. 5 is a plan showing a modified construction, of which Fig. 6 is a vertical section on the line 6 6. Fig. 7 is a fragmentary vertical section, and Fig. 8 is a plan showing the stuffing-box, Fig. 9 being a plan and edge view of one section thereof. Fig. 10 is a similar view to Fig. 8, showing a more highly developed construction. Figs. 11 and 12 are similar views showing modifications. Fig. 13 is a plan of a furnace-top with four pencils, and Fig. 14 is a vertical mid-section thereof.

Let A designate the pot or crucible of the furnace, which may be round, square, or of any other cross-section. This pot is shown as made up of a lower section *a* and an upper section *b*, preferably provided with flanges *c* at their junction. The upper section is kept in its place on the lower one by its weight, although it may be connected by bolts or clamps engaging the flanges. Between the flanges I usually put a luting of clay or other soft material to make a tight fit; but this is not always necessary. The base-section has a tap-hole *d*, and in the upper section is a smoke-hole *e*, which may be connected to any suitable flue or led to a furnace for consuming the gases. To facilitate lifting, the upper section *b* is provided with lugs *f f* on opposite sides, which may be easily engaged by grappling-hooks connected with a crane or hoist.

The pot, which is of cast-iron or sheet-iron, has a refractory lining *g*, which may be of carbon. For convenience in handling the furnace the pot is mounted on a truck which rolls on a track.

The pot forms one of the electrodes, as indicated by the circuit-wire *w*, although in practice the electric connection may be made through the track and wheels. The other electrode consists of a carbon pencil or bar B, (usually a group or bunch of bars or slabs,) which projects into the top of the pot and is movable up or down therein, being usually carried in a holder *h* at the bottom of a vertically-movable upright bar *i*, to which usually the circuit connection is made, as indicated by the wire *w'*. A continuous or an alternating current may be used.

The furnace has a flat top C, having a hole through which the carbon pencil passes to enter the furnace-chamber. The top is made up of sections, which can be removed separately, but which when in place fit together as one plate. These sections are hollow, and water is circulated through them by means of flexible pipes or hose *k k'*, which conduct the water respectively to and from the sections, each section having such an inlet and outlet pipe.

The purpose of the water circulation is to keep the furnace-top cool and prevent its fusing under the electrically-generated heat within the furnace. The sections are best
 5 made of metal, preferably cast-iron, and as they are in contact with the electrode B they require to be insulated from the pot A, which constitutes the opposite electrode. For this purpose I introduce a layer *l* of insulating
 10 material, which may be a course of ordinary brick with or without a luting of clay or mortar.

The purpose of constructing the top or cover C in sections is to facilitate stoking the furnace. For this purpose one of the front or
 15 back sections *m m* of the top, which I call the "hatches," is removed or lifted off, for which purpose I provide these sections with handles *m'*. One man can easily lift or remove one
 20 of these hatches, which is always kept cool by the circulating water, either by lifting it by hand or by a chain or hoist. By lifting off one hatch at a time the attendant can stoke the furnace at front or rear and to either side
 25 of the carbon pencil.

In order to remove the furnace-pot, it is necessary after lifting the carbon pencil B to lift off the entire top C. For this purpose I provide two bars of iron, one of which is shown
 30 at D in Fig. 4, which bars are run under the ends of the top sections in positions shown at D D in Fig. 1, and by connecting a chain *p* to the ends of the bars and lifting this chain by a small block and tackle or other suitable
 35 hoist the entire top can be easily raised a short distance sufficient to run the pot out from under it and put another pot in its place, whereupon the top is lowered on the pot.

For large furnaces I may use a little different arrangement, as shown in Fig. 5. Such
 40 larger furnaces are preferably round, and hence the top is also round. To facilitate handling the top, I prefer to subdivide it into a greater number of sections than in the
 45 smaller furnace just described. The hatches *m*, of which there are two or more, are much smaller in proportion, each hatch being seated on rabbets or ledges in a recess formed in the adjacent cover-section in the manner shown
 50 in sectional view Fig. 6. The hatches have the same handles *m'*. In this construction the same water circulation is provided for both in the main sections and in the hatches *m*, the circulation through the latter being
 55 insured by dividing its water-jacket by means of the central partition, as shown in Fig. 5, where one of the hatches is in section.

For larger furnaces I prefer, according to my complete invention, to provide a plurality
 60 of pencils. A furnace thus constructed is shown in Figs. 13 and 14, where I have shown four pencils, although other numbers might be used. Each pencil may be in one piece or may be built up of as many carbon bars
 65 as may be desired. Each pencil may carry, preferably, about one thousand to twelve

hundred amperes and each is movable up and down independently of the others. All have the same voltage, since all are connected with the same source of electricity.
 70 This is indicated diagrammatically by the circuit connections shown at *w* and *w'*, the latter being subdivided into four branches leading to the holders of the respective pencils. By means of suitable switches—such as
 75 the switches indicated diagrammatically at *γ*, Fig. 14—each pencil can be switched in or out of circuit independently of the others. Where a large current is required, this multiple furnace possesses great advantage, since
 80 by this arrangement the heat can be distributed over a large area within the furnace, which practically is of great importance. For example, if from four thousand to five
 85 thousand amperes are required the use of this current with one pencil would so concentrate the heat that the temperature would become too high for many smelting operations; but by dividing the current among, for example,
 90 four pencils, this difficulty is overcome. Also one pencil carrying such a load is very difficult to manage, and the resulting fluctuations involve a heavy strain upon the dynamo; but by subdividing the load among several
 95 pencils their fluctuations are averaged, to the great relief of the machinery, since the furnace then becomes, in effect, a combination of as many small furnaces as there are independent pencils.

The water-cooled top C may be subdivided
 100 into sections in various ways, the particular means of subdivision not being material to my invention. The arrangements I have shown are deemed preferable for their respective sizes of furnace; but other modifications
 105 may be used.

On the top C and around the pencil B is provided a stuffing-box E for the purpose of excluding air from the furnace. The stuffing-box is constructed of loose pieces *q q* of
 110 sheet-iron, which may be four in number, as shown in Fig. 8, one of the pieces being shown separately in Fig. 9. These pieces or sections have each a base-plate *r*, which lies flat upon the furnace-top and is fastened to it by screws
 115 or clamps, and an upright portion *s*, which projects upwardly from the base in such shape as to form between itself and the pencil B a chamber into which asbestos fiber or other suitable packing material may be filled. The
 120 sections *q q* are usually required to be adjustable in order to accommodate the stuffing-box to variations in the dimensions of the carbon pencil B. Hence the base-plates are preferably formed with slots *t t*, by which they
 125 may be adjusted relatively to the fastening devices. These fastening devices are preferably studs *u u*, projecting from the top C and screw-threaded to receive thumb-nuts *u'*, which can be screwed on by hand to clamp
 130 the sections in any position more or less removed from the pencil. I prefer four sec-

tions q , as shown in Fig. 8, in which case their base-plates should be prolonged and overlapped. A more refined construction is shown in Fig. 10, where corner-pieces q' are added cooperating with the sections q and make an expanding or contracting stuffing-box adapted to fit pencils of different sizes and shapes. Fig. 12 shows a construction in which the stuffing-box is made of two sections each reaching partly around three sides of the pencil and telescoping one another, so as to accommodate the stuffing-box to different widths of pencil, a construction suitable when the pencil does not vary materially in one direction, but does in the other. Fig. 11 shows a construction wherein the stuffing-box is made up of two sections q , each embracing two sides of the pencil and meeting at diagonally opposite corners thereof. The stuffing-box sections having been adjusted sufficiently close to the pencil, some long-fibred asbestos is placed between their upright portions s and the pencil, and on top of these is put some of the mixture that is being fed into the furnace.

The purpose of the furnace-top C is to close the top of the furnace and prevent currents of air flowing into and out of the furnace-chamber, which would oxidize and rapidly consume the heated carbon of the pencil, causing it to waste away rapidly. The top-sections by fitting closely together and by making close fit with the top of the pot, with the addition of the stuffing-box, effectually prevent all admission of air to the furnace-chamber, and thereby protect the carbon pencil from burning at its sides, thereby confining its consumption to its end from which the arc springs, and hence greatly lengthening the life of the pencil. In low upright furnaces of this character any material used for a top or cover, no matter how refractory, is destroyed more or less quickly by the heat directly over the arc unless provision be made for constantly cooling it. A top or cover having provision for water circulation through it is the only construction which could be practically used for covering such a furnace.

If the iron top were to arc either with the pencil or with the furnace-pot, it would almost certainly be damaged by the burning of holes in it. Such arcing with the pot is prevented by the luting l , already referred to, which should be at least two inches thick. For preventing arcing between the top and the carbon pencil or holder I insure that the top shall be given the same voltage as the pencil. To this end I connect the top with the carbon-pencil holder by means of copper wires, as indicated at v , Fig. 1.

The furnace should be tapped at regular intervals when operating with any product that is capable of being tapped out. The liquid slag can also be run out through the tap-hole d or through a separate slag-hole. Under such conditions the furnace, if well at-

tended to, can run continuously for any length of time.

The making of the furnace-pot A in two sections a b is found to be of great advantage in cleaning the furnace at the end of a run. The cake of product or slag which solidifies in the furnace can easily be removed in one piece without injuring the carbon lining by first lifting off the upper section b of the pot and then lifting out the cake or pig.

It will be understood that the furnace to which my invention pertains is ordinarily operated as an arc-furnace, the arc being of large area and occupying the space between the parallel horizontal surfaces of the lower end of the electrode B and the bath of fused material in the pot. Such a furnace may, however, be operated as an upright incandescent furnace.

My furnace is absolutely free of dust, wherein it is a great improvement over prior electric furnaces.

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

1. In an electric furnace the combination with the pot and carbon pencil entering it, of a cover for the furnace consisting of a plurality of sections fitting closely together, each formed of hollow metal with a water-chamber within it and water-pipes for causing water to flow through said chamber, the opening through which said pencil passes being formed partly in each of two adjoining sections, which may remain in place undisturbed during the operation, while other sections are removable independently thereof for stoking.

2. In an electric furnace, the combination with the pot A and carbon pencil B entering it, of a cover C for said pot having a hole through which said pencil may pass, and constructed in sections, said sections fitting closely together and being separately removable, and bars D-D taking under the ends of said sections for lifting said cover bodily.

3. In an electric furnace, the combination with a pot or crucible, a carbon pencil entering therein, a cover for said pot, insulated from the pot, electrically connected to the carbon pencil, and having an opening through which the carbon pencil may pass, and a loose stuffing-box applied to said cover around said pencil, comprising a fibrous packing, and means for retaining the same against the pencil, said stuffing-box adapted to permit the pencil to be freely adjusted through it, while preventing gases passing through the opening around the pencil.

4. In an electric furnace, the combination with a pot or crucible, a carbon pencil entering therein, a cover for said pot having an opening through which the pencil may pass, and a stuffing-box applied to said cover around said pencil, consisting of relatively adjustable sections of sheet metal having each a base or flange and means for fastening the

same adjustably to said cover, and having each an upper portion adjacent to the pencil forming a chamber for retaining a fibrous packing against the pencil.

- 5 5. In an electric furnace, the combination with pencil B and cover C, of a stuffing-box E comprising sheet-metal sections *q q* having slotted base-flanges *r* and upright chambered portions *s*, with clamping devices for engag-

ing their base portions and fastening them adjustably to the cover.

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

GUILLAUME DE CHALMOT.

Witnesses:

JOHN W. HARVEY,
E. W. POINDEXTER.