No. 819,224. PATENTED MAY 1, 1906.

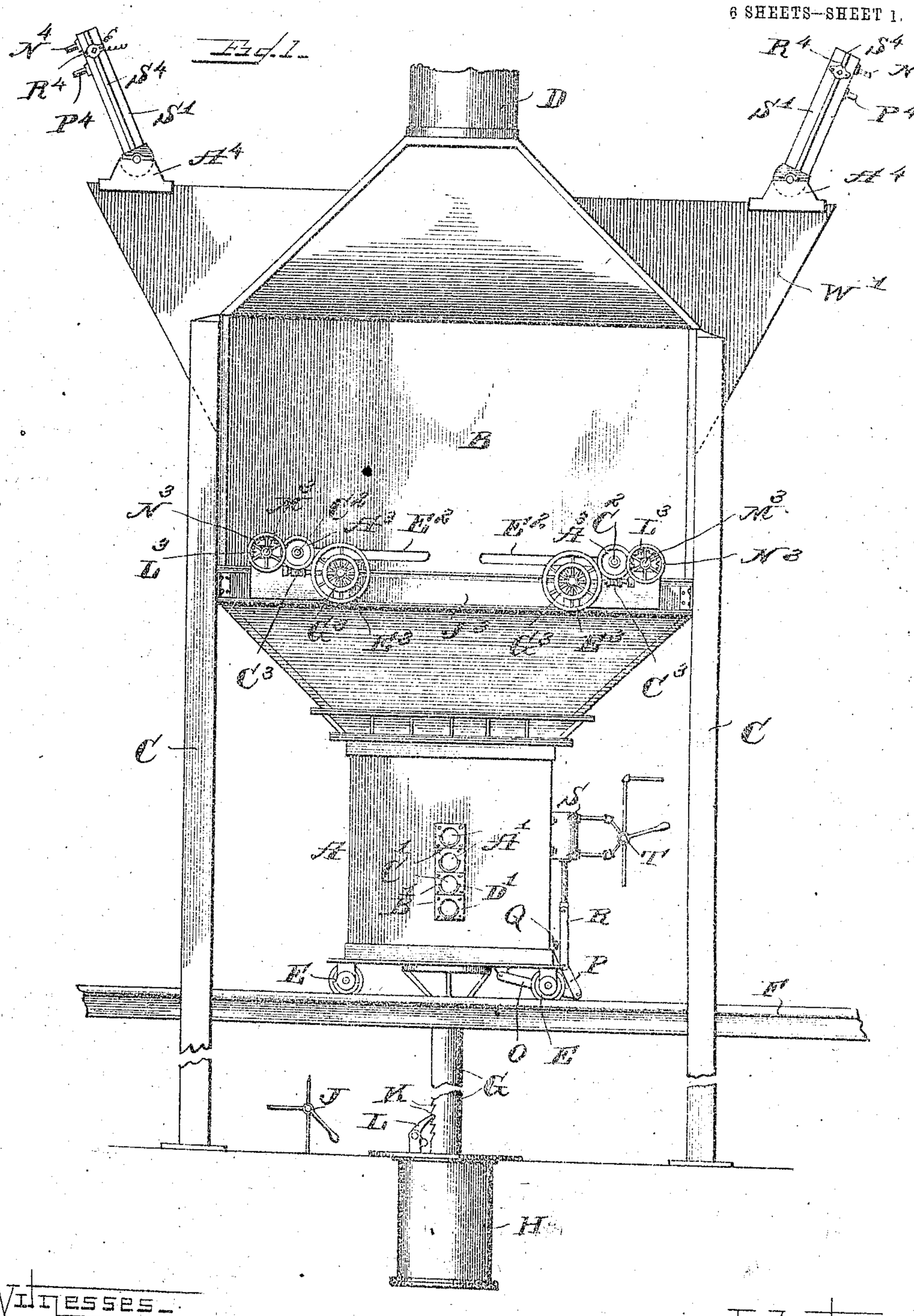
H. L. HARTENSTEIN.

ELECTRIC FURNACE.

APPLICATION FILED JULY 26, 1902. RENEWED SEPT. 30, 1905.

6 SHEETS—SHEET 1.

Fig. 1.



Witnesses.

G. A. Fairbrother

E. C. Semple.

Inventor.

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Attys.

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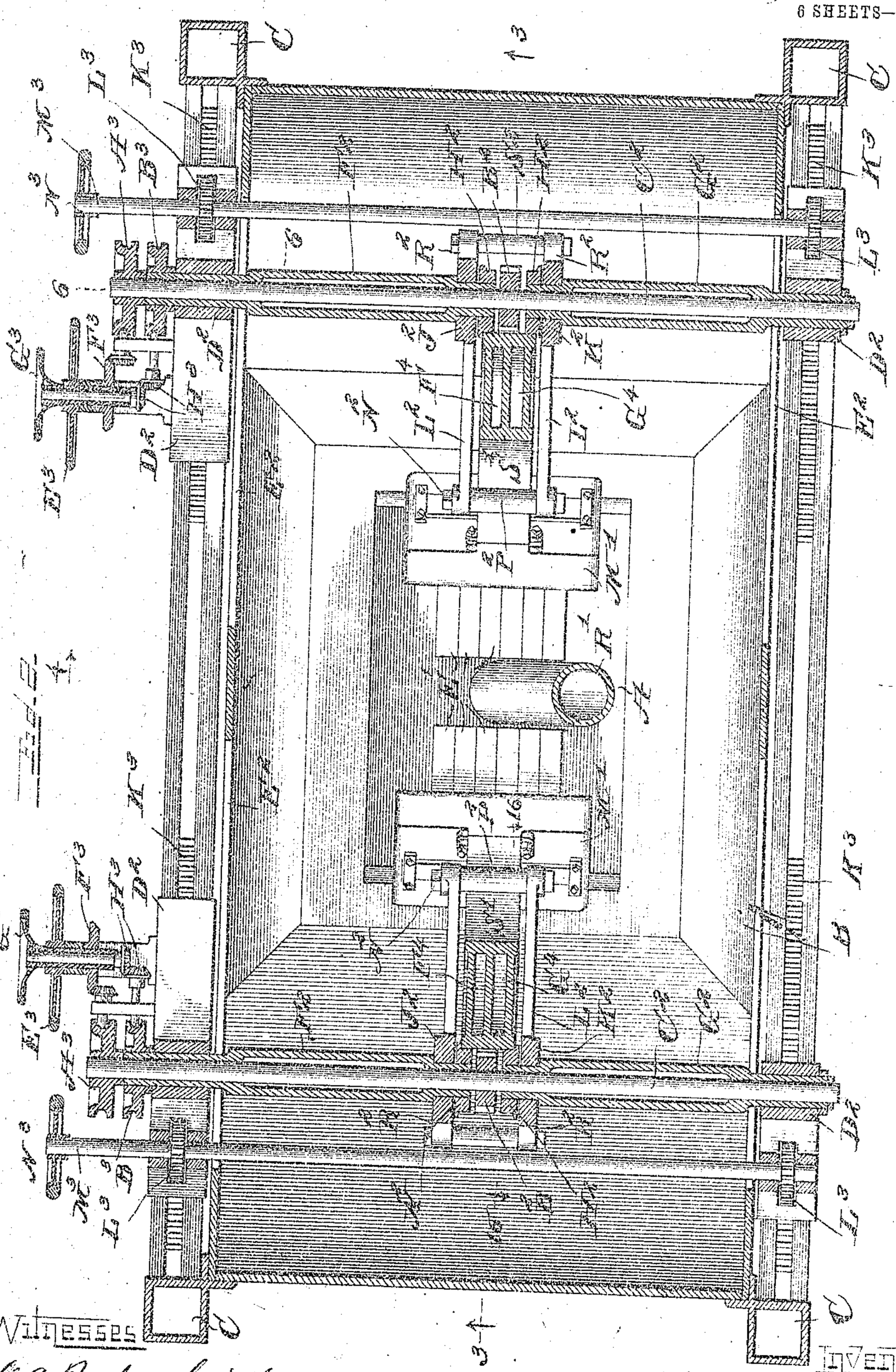
6 SHEETS—SHEET 2.



Witnesses
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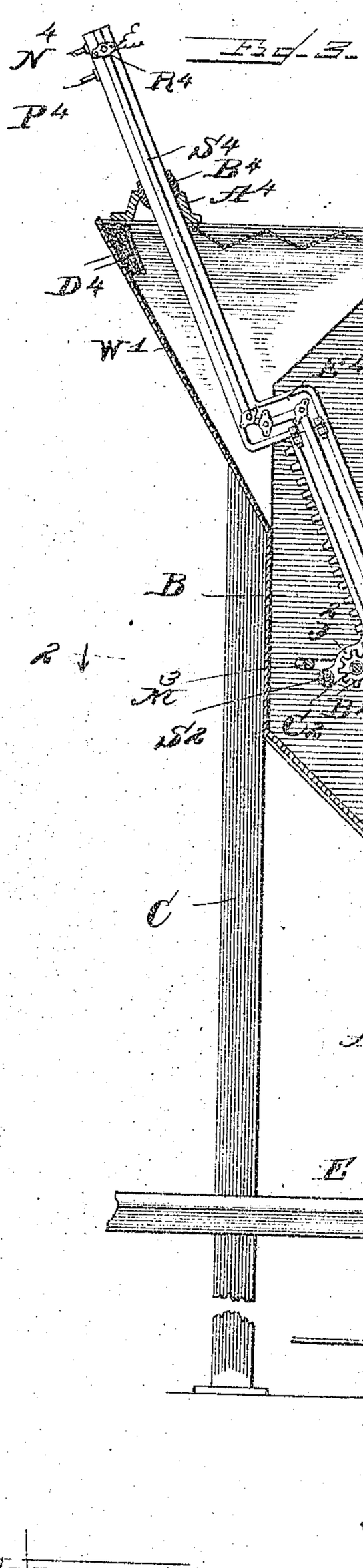
6 SHEETS—SHEET 3.



Witnesses.

C. A. Parkes Smith

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No. 819,224. PATENTED MAY 1, 1906.

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6 SHEETS—SHEET 4.

Fig. 4.

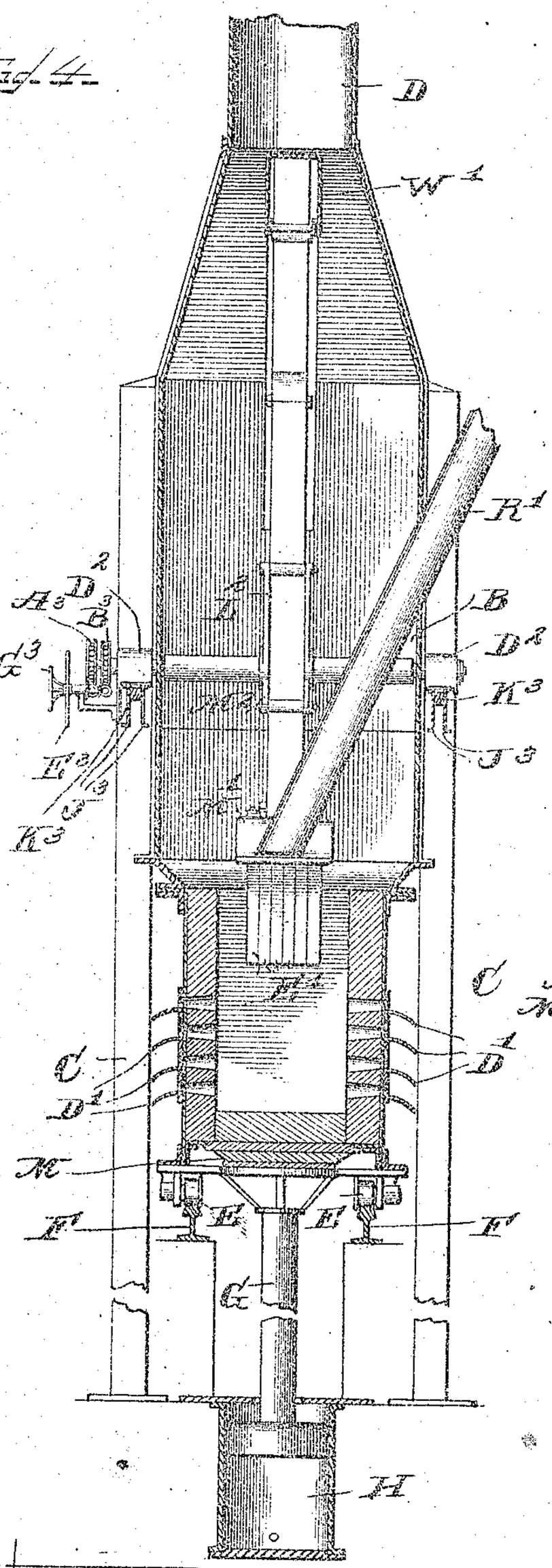


Fig. 5.

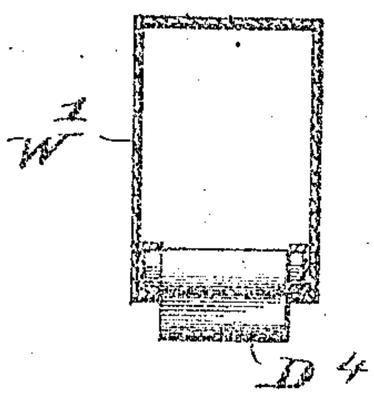


Fig. 6.

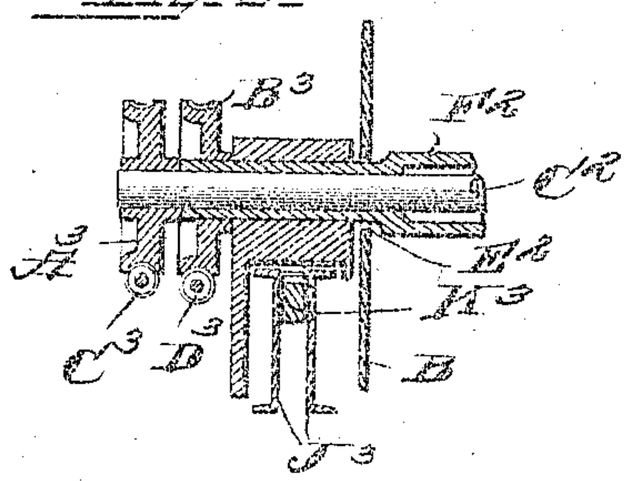
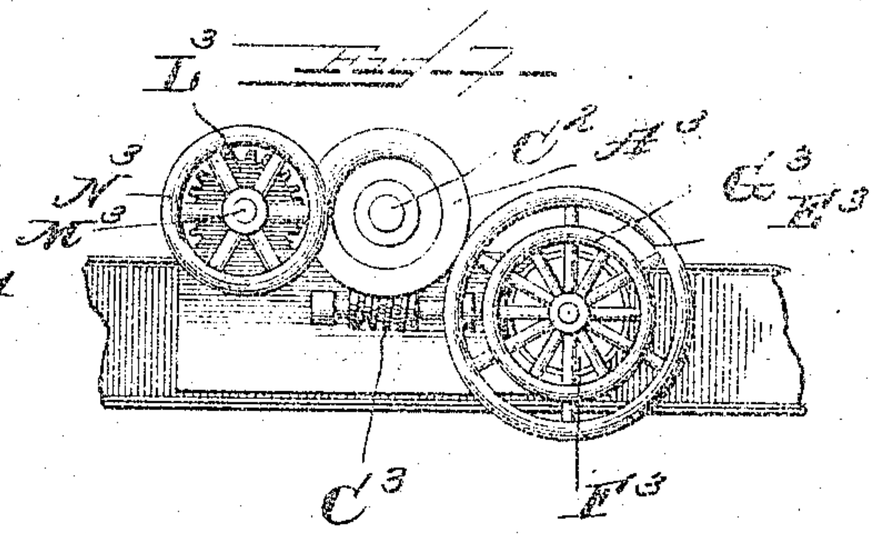


Fig. 7.



Witnesses.

G. A. Barbeschmidt

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No. 819,224. PATENTED MAY 1, 1906.

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6 SHEETS—SHEET 5.

Fig. 8.

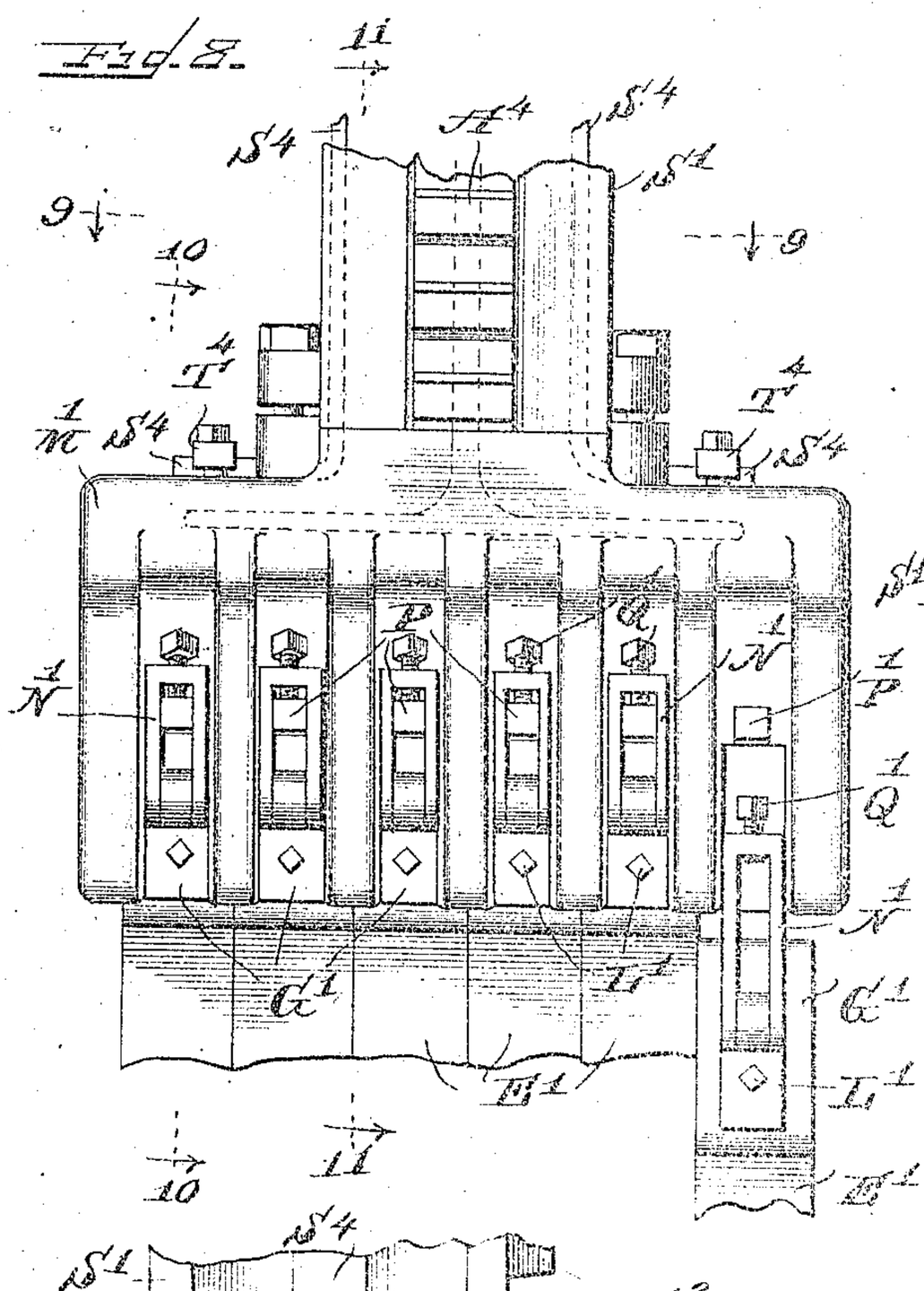


Fig. 9.

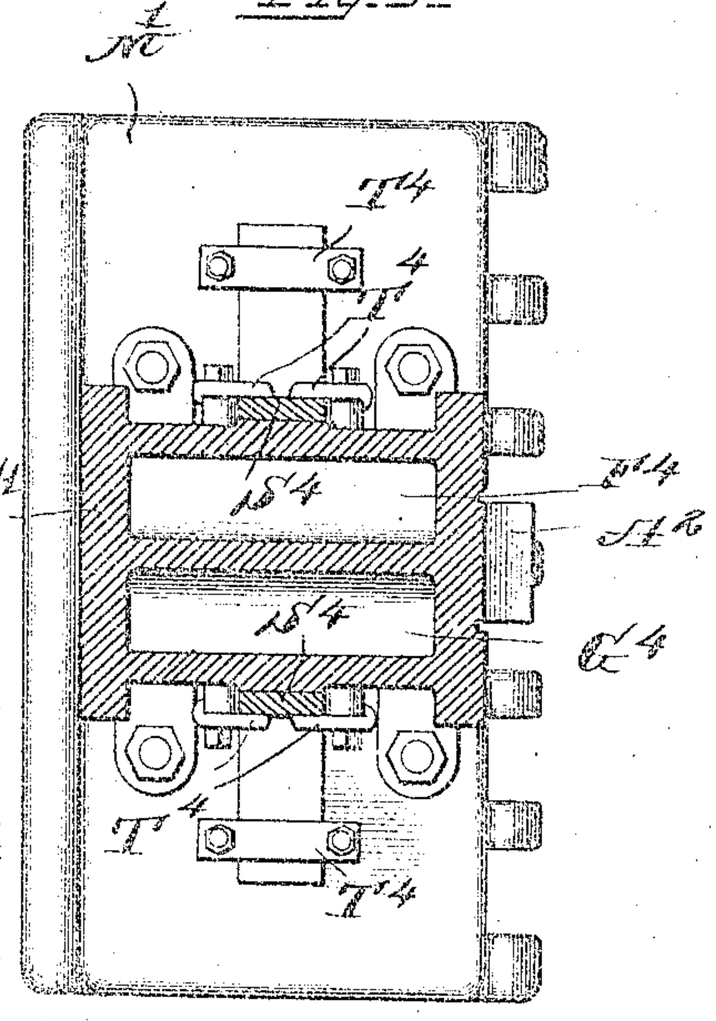


Fig. 10.

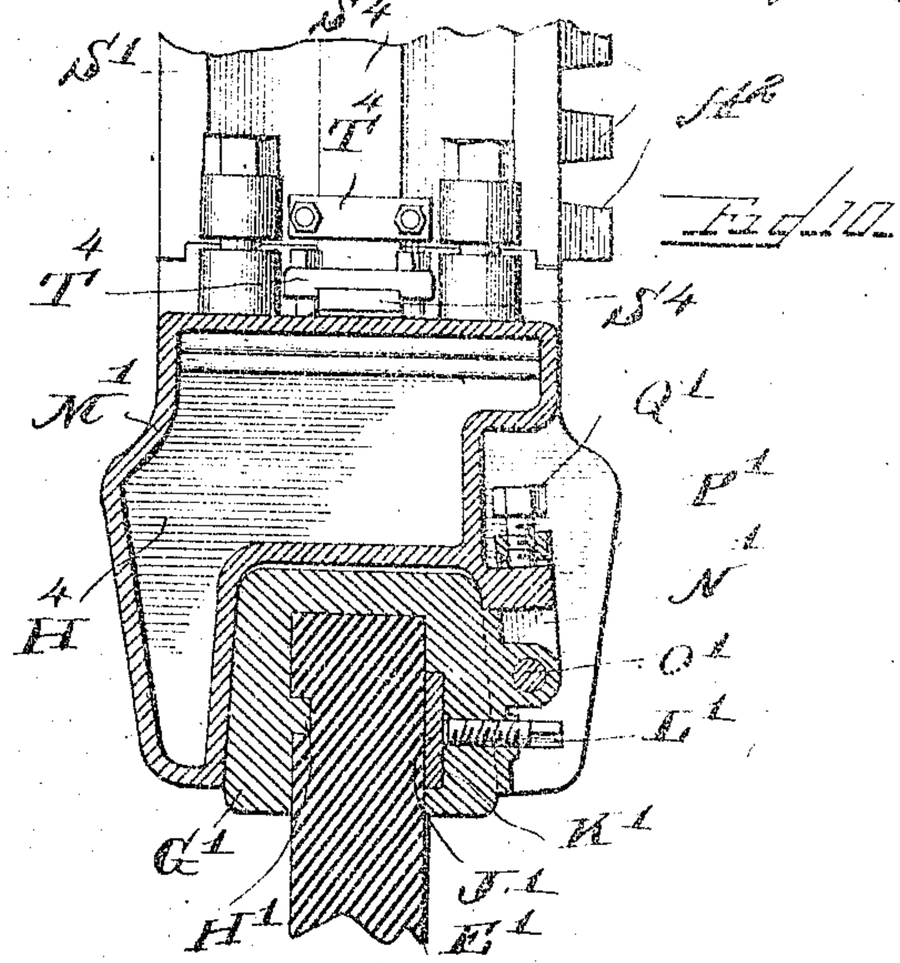
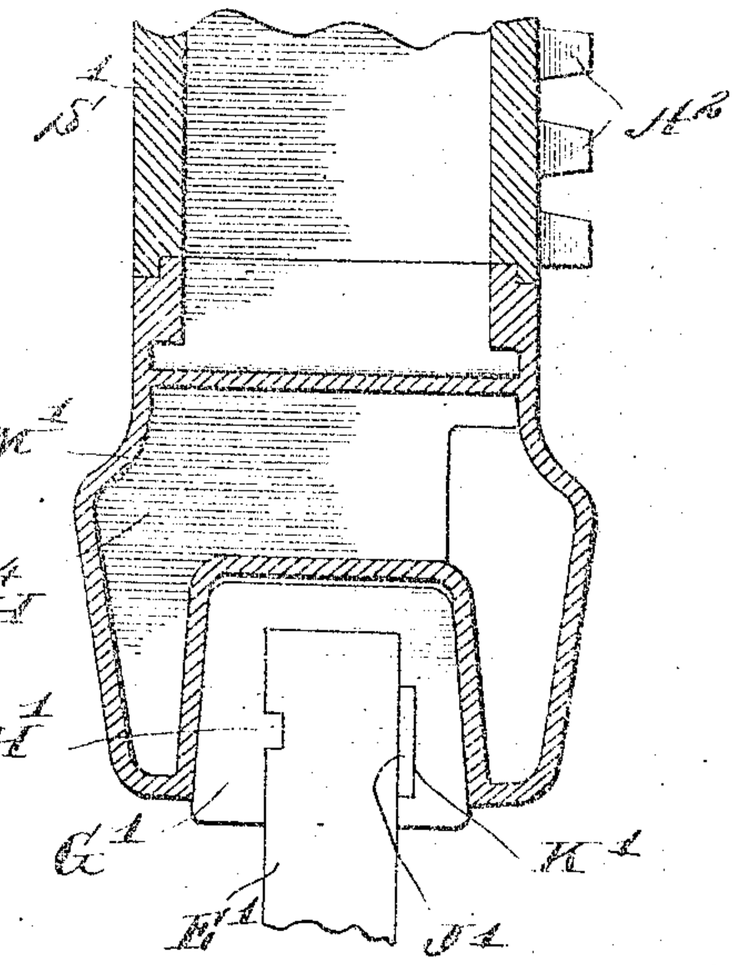


Fig. 11.



Witnesses.

G. A. Rauberschmidt.

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No. 819,224. PATENTED MAY 1, 1906

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ELECTRIC FURNACE.

APPLICATION FILED JULY 26, 1902. RENEWED SEPT. 30, 1905.

6 SHEETS—SHEET 6.

Fig. 12.

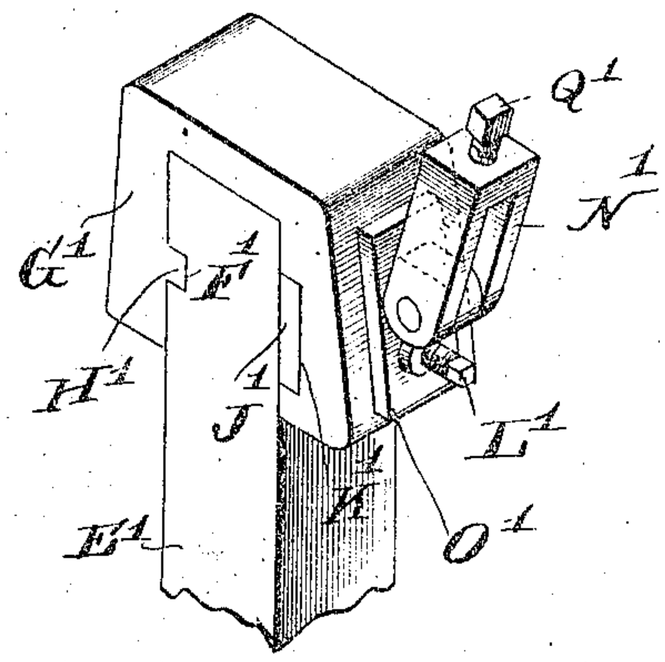


Fig. 14.

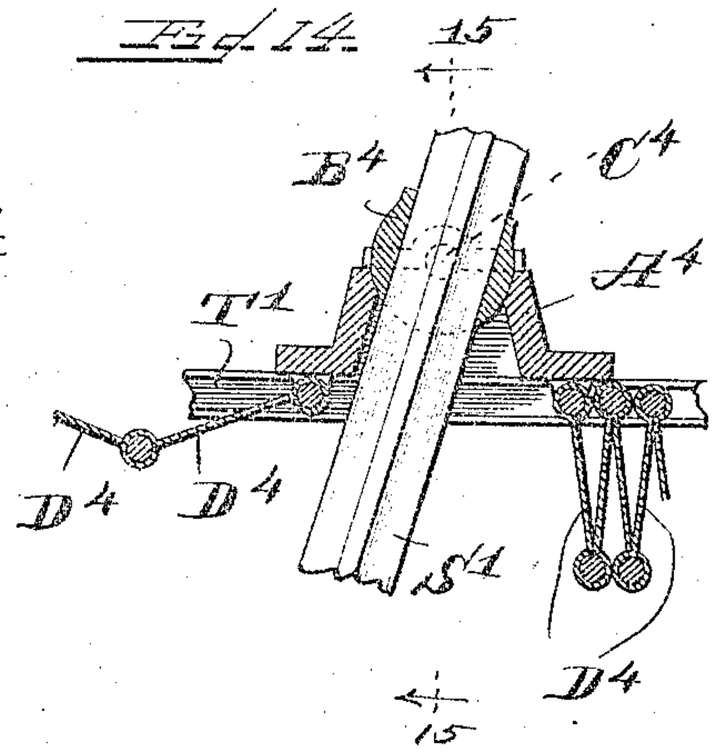


Fig. 13.

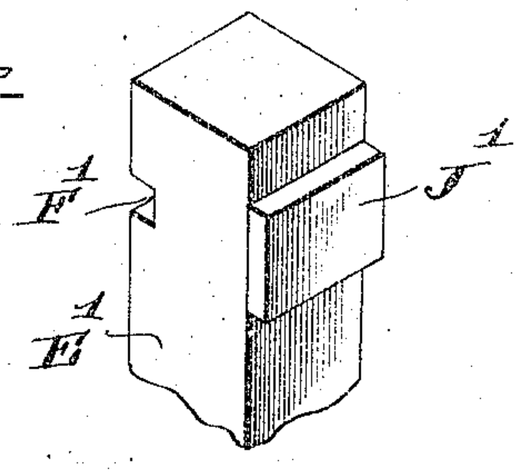
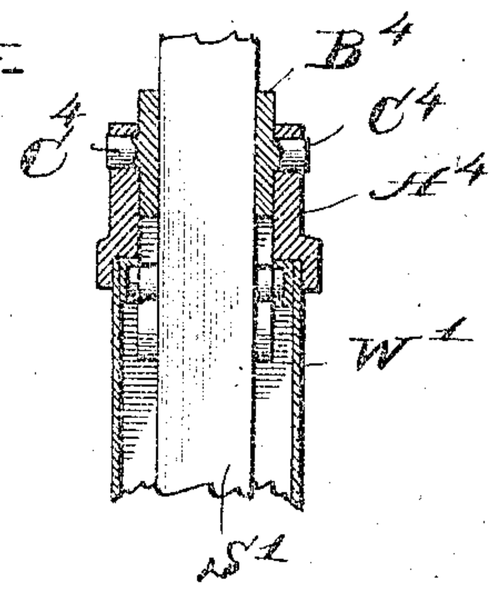


Fig. 15.



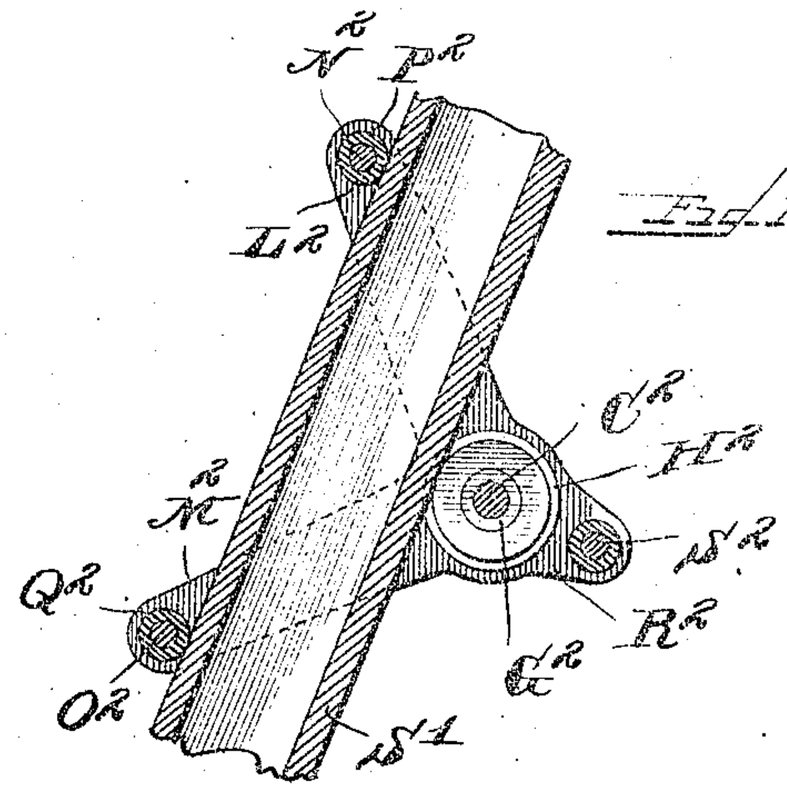


Fig. 16.

Witnesses.

G. A. Rauchenschmidt.

E. C. Semple

Inventor.

Herman L. Hartenstein

By Brown & Darby

Attys.

UNITED STATES PATENT OFFICE.

HERMAN L. HARTENSTEIN, OF CHICAGO, ILLINOIS, ASSIGNOR, BY MESNE ASSIGNMENTS, TO ELECTRO CHEMICAL & DEVELOPMENT COMPANY, OF PIERRE, SOUTH DAKOTA, A CORPORATION OF SOUTH DAKOTA.

ELECTRIC FURNACE.

No. 819,224. Specification of Letters Patent. Patented May 1, 1906.

Application filed July 26, 1902. Renewed September 30, 1905. Serial No. 280,729.

To all whom it may concern:

Be it known that I, HERMAN L. HARTENSTEIN, a citizen of the United States, residing at Chicago, in the county of Cook and State of Illinois, have invented a new and useful Electric Furnace, of which the following is a specification.

This invention relates to electric furnaces.

The object of the invention is to simplify and improve electric furnaces, and especially furnaces of this class designed for use in the manufacture of calcium carbid.

A further object of the invention is to provide means whereby the position of the carbons may be readily adjusted with reference to each other and with reference to the material to be fused or melted.

A further object of the invention is to provide an improved construction of carbon-holder for use in electric furnaces which is simple and efficient and wherein the carbon elements may be readily removed or replaced.

Other objects of the invention will appear more fully hereinafter.

The invention consists substantially in the construction, combination, location, and arrangement of parts, all as will be more fully hereinafter set forth, as shown in the accompanying drawings, and finally pointed out in the appended claims.

Referring to the accompanying drawings, and to the various views and reference-signs appearing thereon, Figure 1 is a view in front elevation of a construction of electric furnace embodying the principles of my invention. Fig. 2 is a horizontal sectional view on the line 2 2 of Fig. 3 looking in the direction of the arrows. Fig. 3 is a view in vertical section on the line 3 3 of Fig. 2 looking in the direction of the arrows. Fig. 4 is a view similar to Fig. 3, taken in a plane at right angles to the plane of section of said Fig. 3 and on the line 4 4 of Fig. 2 looking in the direction of the arrows. Fig. 5 is a detail sectional view on the line 5 5 of Fig. 3 looking in the direction of the arrows. Fig. 6 is a broken detail view in section on the line 6 6 of Fig. 2. Fig. 7 is a broken detail view in side elevation of the carbon-holder-adjusting mechanism. Fig. 8 is a broken detail view, in side elevation, of the carbon-holder, one of the carbons being shown in the act of being removed or inserted in place. Fig. 9 is a detail view in section on the line 9 9 of Fig. 8 looking in the direction of the arrows. Fig. 10 is a broken detail view in section on the line 10 10 of Fig. 8 looking in the direction of the arrows. Fig. 11 is a broken detail view in section on the line 11 11 of Fig. 8, looking in the direction of the arrows. Fig. 12 is a broken detail view in perspective of a carbon element and its clamping-block detached from the holder. Fig. 13 is a view similar to Fig. 12, showing the clamping end of a carbon. Fig. 14 is a broken detail view in section, showing the rocking slide-guide of the carbon-holder and means for closing the opening in the furnace-casing through which the holder projects and operates. Fig. 15 is a detail view in section on the line 15 15 of Fig. 14. Fig. 16 is a detached detail view in section on the line 16 16 of Fig. 2 looking in the direction of the arrows and showing the means for guiding and tilting the carbon-holder. Fig. 17 is a detail view in section through a discharge-opening.

The same part is designated by the same reference-sign wherever it occurs throughout the several views.

In the manufacture of carbolite or calcium carbid a charge of the material is delivered into an electric or other furnace, where such charge is subjected to a degree of heat sufficient to fuse or melt the same, the melted product forming the carbid to be produced. Where an electric furnace is employed for effecting the fusing or converting operation, the charge is delivered into a suitable chamber containing carbons arranged in an electric circuit. Current is supplied to said circuit to form an arc between the carbons. In the efficient operation of an electric furnace and in the manufacture of carbid it is important to provide a construction and arrangement whereby the voltage of the current employed may be varied according to the amount of charge delivered to the furnace-chamber or to the conditions of the carbon electrodes, and to this end in carrying out my invention I propose to provide a construction and arrangement wherein the carbon electrodes may be adjustable toward or from each other. I also propose to provide a construction wherein the carbons or electrodes may be adjusted longitudinally, wherein the slant or inclinations of the carbons or electrodes with reference to each

other may be readily adjusted, and wherein the carbons or electrodes may be independently adjustable, thereby enabling me to arrange the carbons or electrodes according to the amount of the charge delivered to the furnace-chamber or according to the condition of the carbons or electrodes themselves.

It is also important in apparatus of this nature to provide means whereby the carbons or electrodes while efficiently clamped or held in place during operation may be readily removed or replaced when desired or when worn or burned off. I therefore propose in carrying out my invention to provide a construction of carbon-holder wherein provision is made for the ready removal or replacement of the carbons constituting the electrodes.

It is also desirable in order to secure the best results that the charge to be operated on in the furnace-chamber be delivered into the space between the electrodes or carbons rather than outside of or surrounding the carbons. In carrying out my invention, therefore, I propose to provide means whereby the charge is delivered into the furnace-chamber at a point between the carbons or electrodes.

In the operation of an apparatus of the character referred to it is desirable to provide against the too rapid burning out of the carbon-holders. I therefore propose to provide means for protecting the holders as much as possible from the heat generated in the furnace-chamber.

In apparatus of the class to which my invention relates it is desirable to provide means whereby the furnace-chamber may be cleaned out whenever desired. I therefore propose in carrying out my invention to provide means for readily removing the furnace-chamber and dumping the contents thereof to clean out any slag or incrusted material that may form or adhere to the inner surface of the chamber.

These and other objects of my invention, hereinafter to be referred to, are accomplished in the construction illustrated in the accompanying drawings, wherein—

Reference-sign A designates the furnace-chamber, which may be of suitable construction and arrangement and suitably lined, if desired, and of suitable proportions or size dependent upon the producing capacity and power at which it is desired to run the plant.

B designates a casing suitably supported by the stanchions or posts C and preferably in the form of a hopper directly over the furnace-chamber A and delivering into said furnace-chamber. Communicating with the casing B is a stack D to carry off the smoke, fumes, or other similar products of combustion carried on in the furnace-chamber.

The furnace-chamber A is provided with truck-wheels E, operating on track-rails F, by which means said chamber may be readily brought into position beneath the hopper or casing B or removed therefrom when desired.

G designates a hydraulic or other form of ram operating in a cylinder H and arranged in position for the head of said ram to be brought into bearing against the bottom of chamber A when the latter is in position underneath the casing or hopper B, so that when an operating medium is supplied to cylinder H to raise the ram the head of said ram engages the bottom of the furnace-chamber and raises the same into efficient bearing against the delivery-mouth of the casing or hopper B. Only a slight clearance between the upper edge of the furnace-chamber and the lower edge or delivery-mouth of the casing or hopper B is provided, so that only a slight movement of the ram is necessary to raise the furnace-chamber into bearing against hopper or casing B. The supply of operating medium to and from cylinder H may be controlled by means of a hand-operated valve J in any suitable or convenient manner.

If desired, the ram G may be provided with ratchet-teeth, (indicated at K, Fig. 3,) with which coöperates a gravity-pawl L to maintain said ram in proper position when raised without depending upon the operating medium in cylinder H. When it is desired to remove the furnace-chamber, the gravity-pawl L is released from engagement with the ratchet-teeth K, and the control-valve J is manipulated to permit the ram G to descend sufficiently for the truck-wheels E to bear upon the track-rails F and to receive the weight of the furnace-chamber, and said furnace-chamber may then be shoved or pushed or otherwise moved along the track-rails F and from beneath the hopper or casing B. The bottom of the furnace-chamber A is formed into a door M, hinged or pivoted, as at N. (See Fig. 3.) To this hinged or pivoted door is connected one end of a link O. To the other end of said link is pivotally connected one end of a lever P, said lever being pivoted, as at Q, to a fixed part or bracket carried by the furnace-chamber. A piston-rod R is pivotally connected to lever P, said piston-rod being operated from a cylinder S, carried on the side of the furnace-chamber and to or from which an operating medium may be supplied or exhausted from any convenient source by means of a control-valve T.

From the foregoing description it will be seen that by suitably controlling the operating medium in cylinder S the hinged or pivoted door M of the furnace-chamber may be opened or closed, as may be desired.

In order to enable the fused or converted mass to be tapped from the furnace-chamber, I provide said furnace-chamber with discharge-openings, (indicated at A′,) and in order to protect said discharge-openings, as

well as the outer casing of the furnace-chamber, I employ slabs or plates B′, suitably bolted on the outside of the furnace-chamber casing and with openings C′ therethrough arranged to be brought into coinciding relation with respect to the discharge-openings A′. In practice I prefer to employ a separate slab or plate B′ for each discharge-opening A′, so that in case a slab or plate is burned off or injured it may be removed and replaced without disturbing the other slabs or plates B′. Preferably I provide each slab or plate B′ (see Fig. 17) with a delivery-spout D′ to facilitate the discharge of the molten material from the furnace-chamber.

I will now describe the means for clamping or supporting the carbon electrodes. Ordinarily the electrodes employed are made of carbon slabs E′, though I do not desire to be limited in this respect. At its upper end each carbon slab is provided with a groove or recess F′. G′ designates a block having a seat formed therein adapted to receive the end of a carbon or slab E′. Each block G′ is provided with a lug or projection H′, adapted to be received in the slot or recess F′ (see Fig. 13) formed in the carbon. The carbon is inserted laterally into place in a block G′ (see Figs. 10 and 11) and is efficiently supported and held in place and prevented from dropping out by the engagement of the rib or lug H′ within the recess or slot F′.

In order to insure efficient contact and at the same time to avoid the bearing of a contact or pressure screw directly against the carbon slab, I employ a plate J′, of metal, copper, or other suitable material, and arrange the same to bear against the side of the carbon slab or electrode E′, and the block G′ is suitably recessed, as shown at K′, to receive the plate or block J′. A set-screw L′, tapped through block J′ and bearing against the block or plate J′, serves to press said block or plate firmly against the carbon or electrode E′, thereby maintaining efficient electrical contact of said electrode or carbon with block G′.

In order to enable the charge of material to be delivered into the space between the carbons or electrodes, I provide the casing or hopper B with a charging-opening (indicated at R′) and so situated with reference to the carbons or electrodes that when the charge is delivered through said charging-opening said charge will drop into place between the electrodes or carbons, as most clearly shown in Fig. 3.

Reference-sign M′ designates a carbon-holder provided with seats adapted to receive the blocks G′. I have shown the holders M′ arranged to receive six blocks G′ and carbons E′; but it is obvious that the holders may be constructed to receive any desired number of blocks G′ or carbons E′. The blocks G′ may be independently and removably held in place in any suitable manner. I have shown a convenient arrangement wherein a strap N′ (see Figs. 8 and 12) is hinged or pivoted, as at O′ to a lug formed on block G′ and arranged to be swung over a lug or extension P′ formed on head M′. A set-screw Q′, tapped through strap N′ and bearing upon lug P′, serves to draw the head G′ firmly and efficiently into place and contact in its seat in head M′.

From the foregoing description it will be seen that any individual carbon or electrode may be readily and quickly removed or replaced without disturbing the others by simply loosening up on set-screw Q′ and swinging the yoke or strap N′ out of engaging relation with respect to lug P′, thereby leaving block G′, carrying a carbon, free to drop out of place, and the carbon or electrode may be readily removed from the block G′ by loosening up on set-screw L′ and then sliding the slab or carbon E′ laterally out or its seat in block G′. These I regard as important features of my invention, inasmuch as they enable me to readily remove or replace a carbon or electrode or a head G′ without disturbing any of the other parts. From this construction I am also enabled to increase or reduce the number of carbon electrodes employed, as desired, and according to the amount of the charge delivered to the furnace-chamber or according to the current employed.

I will now describe means for adjusting the inclination of the carbons or electrodes with respect to each other or their proximity to each other and their position with reference to the furnace-chamber.

Each holder M′ is carried by a support, (indicated generally by reference-sign S′,) said holder extending in a generally vertical direction and out through a slot or opening T′ in the roof or an extension W′ of the roof of the casing or hopper B. The support S′ is provided with a rack A^2, arranged to extend longitudinally with respect thereto and to be engaged by a pinion B^2, mounted on a shaft C^2, arranged to extend transversely of the furnace-chamber and carried in slide-boxes D^2, (see Fig. 4,) the ends of said shaft projecting through horizontal slots or openings E^2, formed in the side walls of casing or hopper B. By imparting rotation to shaft C^2 a vertical adjustment of support S′ may be effected in order to project the carbon or electrode carried by said support more or less into the furnace-chamber, the upper end of support S′ sliding through a bearing-support or slide-guide arranged to receive the same and suitably mounted in the top plate or roof of the hopper or casing B or the extension W′ thereof, as will be more fully explained hereinafter. Surrounding shaft C^2 is a sleeve made in sections, designated on the drawings by reference-signs F^2 G^2. (See Fig. 2.) Upon the adjacent ends of sleeve-sections F^2 G^2 are mounted friction-rollers H^2, arranged to bear

against the rear or other side of holder S'. (See Fig. 16.) Also mounted upon the adjacent or proximate ends of sleeve-sections F^2 G^2 are plates J^2 K^2, each plate being provided with angle-arms L^2 M^2, projecting in inclined relation with respect to each other and inwardly beyond the inner side of support S'. The arms L^2 M^2 of plate J^2 are spaced apart from the arms L^2 M^2 of plate K^2 a distance sufficient to receive the support S' therebetween, and the inner ends of arms L^2 M^2 of plate J^2 are respectively bolted to the inner ends of arms L^2 M^2 of plate K^2, the securing-bolts being indicated at N^2 O^2. Mounted upon each of the bolts N^2 O^2 (see Fig. 16) are bearing-rollers P^2 Q^2, arranged to bear against the inner side or surface of support S'. In order to still further insure a firm bolting together of the plates J^2 K^2, said plates are provided with outwardly-extending projections R^2, suitably bolted together, as at S^2.

From the foregoing description it will be seen that by rotating one of the sleeve-sections F^2 G^2 such rotation is imparted to the other of said sleeve-sections, and the support S' is rocked in one direction or the other according to the direction in which the sleeve-section is rotated about the bearing of said support upon rollers H^2 as a fulcrum, while at the same time remaining held in place between the arms L^2 M^2 and between the rollers P^2 Q^2, engaging the same on the inner edge thereof, and rollers H^2, engaging the same on the outer edge thereof.

Rotation may be imparted to shaft C^2 and to the sleeve-sections F^2 G^2 in any suitable or convenient manner. A simple arrangement is shown wherein worm-gears A^3 B^3 (see Fig. 2) are respectively mounted upon said shaft and said sleeve-section F^2, said worm-gears meshing with and driven from worms C^3 D^3. The worm C^3 is driven from a hand-wheel E^3 through the intermeshing gears F^3, and similarly the worm D^3 is driven from a hand-wheel G^3 through the intermeshing gears H^3, all of these parts being suitably journaled or mounted in one of the slide-blocks D^2, in which the sleeve-sections and shaft C^2 are journaled.

From the foregoing description it will be seen that by manipulating the hand-wheel G^2 the shaft C^2 is rotated to vertically adjust the carbons or electrodes, and by manipulating the hand-wheel E^3 the sleeve-sections F^2 G^2 are rotated to adjust the angle of inclination of the carbon or electrode.

As above stated, the shaft C^2 and the sleeve-sections F^2 G^2 extend transversely of the casing or hopper B and project through slots or openings E^2 and are journaled or carried in slide-blocks D^2. These slide-blocks or boxes are mounted to travel horizontally upon beams J^3. (See Fig. 6.) Reference-sign K^3 designates racks suitably supported in convenient relation to be engaged by pinions L^2, mounted upon a shaft M^3, and to which shaft rotation may be imparted in any suitable manner—as, for instance, by means of the hand-wheel N^3. From this description it will be seen that the electrodes or carbon-holder may be adjusted laterally. It will also be seen from the foregoing description that the vertical, lateral, or inclined adjustments are wholly independent of each other, thereby enabling corresponding and independent adjustments of the carbon or electrode to be made.

In practice I prefer to employ two or more supports and carbon-holders and sets of carbons or electrodes, and the adjustments above described enable me to independently adjust each set of carbons or electrodes with reference to the other, and this I regard as an important feature of my invention, as it enables me to quickly adjust the relative positions or proximity or inclination of the electrodes or carbons to accommodate any desired charge or any desired condition of electric current employed. In Fig. 3 I have somewhat exaggerated the angle of inclination of the electrodes in order to illustrate the principle of operation of my invention in respect of the relative adjustments above mentioned, and consequently, as shown in said figure, said carbons or electrodes do not project to the distance within the furnace-chamber that said electrodes will occupy when the plant is in operation. In practice the electrodes occupy a more nearly vertical position than that shown in said figure. I have shown only two carbon holders and supports, and the foregoing description of parts applies to either of such holders and supports, as the construction and arrangement thereof and of the adjusting mechanism therefor is the same in each case.

I have above explained that the upper ends of the supports S' project through slots or openings in the top plate or roof of the casing or hopper B or extension W' thereof. The slots T' and the extensions W' are, as shown, of just sufficient extent or width to freely accommodate the upper ends of the supports. In practice I arrange the projecting ends of supports S' to project through insulating blocks or plates B^4, suitably trunnioned or journaled, as at C^4, (see Figs. 14 and 15,) in slide-guides A^4, said slide-guides being mounted to slide freely along or lengthwise with respect to the slots T'. By this construction not only are the supports S' insulated, but the swinging movements thereof during their adjustments are accommodated. In practice the insulating-bearings B^4 are of porcelain.

In order to cover the slots T' E^2 while permitting the swinging movements or adjustments of supports S', I provide a series of cover-plates D^4, suitably hinged or pivoted together, as clearly shown, in connection with

slot T′, so as to be folded up or to be drawn out in accordance with the swinging movements of said supports, thereby forming a cover for the slots T′ in whatever position of adjustment said supports are moved into.

In order to enable the carbons and their holders and supports to be shifted or adjusted into nearly vertical position without interference of the projecting ends of the supports S′ with the stack D, I prefer to provide said holders S′ at some convenient point intermediate their ends, as indicated at E^4, with a bend or offset, as clearly shown in Fig. 3.

In order to efficiently maintain the carbon-holders and their supports cool, so as to avoid burning the same out under the intense heat to which they are subjected, I provide said supports with channels or chambers F^4 G^4, extending throughout the length thereof and communicating with each other within the hollow chamber H^4 of holder M′, and I arrange a suitable hose or other connection N^4 P^4 to respectively communicate with a source of supply and exhaust of a circulating or cooling medium. In this manner I am enabled to maintain the entire holder and its support cool throughout the entire length thereof.

The leading wires of the electric circuit are suitably connected by clips or in any other convenient manner, as at R^4, to copper or other conducting-strips S^4. These conducting-strips extend longitudinally along the supports S′ and at their lower ends are bent outwardly and suitably clamped by means of clips T^4 or otherwise to the holder M′.

Of course it will be understood that the adjusting-gearing should be suitably and properly insulated in order to prevent short circuits and to protect the attendant from receiving a shock when the hand-wheels G^3, E^3, or N^3 are manipulated. The particular arrangement of insulation for accomplishing this result, however, may be readily arranged by any one skilled in the art and forms no part of my present invention.

In operation the carbons or electrodes are properly adjusted and current turned on to establish an arc therebetween. The material or charge is then delivered through the opening R′ and spout A^5 into the space between the electrodes and under the influence of the heat generated is fused or melted and converted into carbid.

By the adjustments above described the relative positions of the carbons or electrodes, their relative inclination or proximity, may be adjusted to accommodate the character or quantity of the charge supplied or the character or quality of current employed. The fused or molten mass is tapped or withdrawn from the furnace-chamber through the discharge-openings A′. When the furnace-chamber becomes clogged for any reason, the current is shut off, the electrodes raised until clear of the furnace-chamber, the ram G is lowered, and the furnace-chamber shifted or moved along the tracks F, and the hinged bottom of said furnace-chamber opened, and the chamber cleaned out. By reason of the independent adjustments of the carbons or electrodes I am enabled to constantly maintain the arc at the lower ends of the electrodes. I am also enabled to so relatively adjust the carbons as to cause the same to be consumed or eaten away in unison, thereby maintaining constancy of arc and securing more uniform results.

It will be seen that by the method of having the electrode-operating mechanisms entirely inclosed within the casing a highly-improved construction is obtained. Such construction enables the casing to be made substantially closed throughout its surface without any holes or openings therein, so that the air within the casing is retained therein. It is advantageous to so confine a single body of air within the casing, for the reason that such confined air becomes deprived of its oxygen, whereby the electrodes are less subject to oxidation. Moreover, there is less opportunity for circulation of air within the furnace, so that such air constitutes a better insulating medium. In addition to this the closed casing construction prevents cold air currents from striking and injuring the heated parts and also prevents heated and noxious gases from entering the room in which the furnace is located.

In a copending application executed July 14, 1902, Serial No. 116,669, I have described a method of operation in which the charge is delivered to the furnace in a highly-heated condition. The present invention is designed for use in connection with such method, but is not limited or restricted thereto. The advantage arising from delivering a highly-heated charge to the electric furnace is that smaller current is required to effect the melting, fusing, or conversion.

While I have shown and described specific constructions as operative embodiments of the features of my invention, I do not desire to be limited or restricted thereto, as many variations and changes in the details of construction and arrangement would readily occur to persons skilled in the art and still fall within the spirit and scope of my invention; but,

Having now set forth the object and nature of my invention and a construction embodying the principles thereof, what I claim as new and useful and of my own invention, and desire to secure by Letters Patent, is—

1. In an electric furnace, a furnace-chamber, electrodes projecting into said chamber, means for adjusting the inclination of said electrodes, independent means for adjusting said electrodes laterally, and means for adjusting the extent of projection of said elec-

trodes into said chamber, as and for the purpose set forth.

2. In an electric furnace, a furnace-chamber, a plurality of electrodes arranged to project into said chamber, means for adjusting the relative inclination of said electrodes, means for adjusting the proximity of said electrodes, and means for adjusting the extent of projection of said electrodes into said chamber, all of said adjusting means being independent of each other, as and for the purpose set forth.

3. In an electric furnace, a furnace-chamber, an electrode arranged to project into said chamber, said electrode provided with a seat or recess, a block having a seat adapted to receive said electrode, a lug formed in said seat and arranged to be received in said recess, means for clamping said electrode in said seat, and a holder arranged to incase and surround said block, as and for the purpose set forth.

4. In an electric furnace, a carbon-holder provided with seats, blocks arranged to be removably received in said seats, and means for clamping carbon slabs in said blocks, as and for the purpose set forth.

5. In an electric furnace, a carbon-holder having seats, blocks arranged to be removably received in said seats, means for clamping said blocks in said seats, and a carbon for each block, and means for removably clamping said carbons in said blocks, as and for the purpose set forth.

6. In an electric furnace, a carbon-holder having a plurality of seats, a block arranged to be received in each seat, a strap connected to each block, means for removably clamping said straps to said holder, whereby said blocks may be independently removed, and a carbon arranged to be removably received in each block, as and for the purpose set forth.

7. In an electric furnace, a holder having seats, a lug or projection associated with each seat, a block arranged to be received in each seat and provided with a pivoted strap arranged to be received over a lug or projection upon said holder, a carbon, and means for removably clamping said carbon in said block, as and for the purpose set forth.

8. In an electric furnace, a carbon-holder, a block adapted to be supported thereby, said block provided with a seat, a carbon adapted to be received in said seat, a clamping-plate arranged to be applied to said carbon, and a set-screw tapped through said block and engaging said clamping-plate to clamp said carbon to said block, as and for the purpose set forth.

9. In an electric furnace, a carbon-holder, a block arranged to be removably supported thereby and provided with a seat, said seat having a recess, a carbon adapted to be received in said seat, a clamping-plate adapted to be received in said recess in position to be applied to said carbon, and a set-screw tapped through said block and bearing against said clamping-plate to clamp said carbon to said block, as and for the purpose set forth.

10. In an electric furnace, a furnace-chamber, an electrode operating therein, a holder for said electrode, a support for said holder, said support provided with rack-teeth, and gearing arranged to engage said rack-teeth to longitudinally adjust said support, as and for the purpose set forth.

11. In an electric furnace, a furnace-chamber, an electrode, a support therefor, means for engaging said support, and worm-and-screw gearing for rocking said engaging means, whereby said support may be tilted, as and for the purpose set forth.

12. In an electric furnace, a furnace-chamber, an electrode, a support therefor, a shaft, bearings swiveled on said shaft and arranged to receive said support therebetween and to engage the same, and means for rocking said bearings to adjust the angular position of said support, as and for the purpose set forth.

13. In an electric furnace, a furnace-chamber, an electrode, a support therefor, a shaft, plates carried by said shaft and having angle-arms arranged to embrace and form a bearing for said support, and means for tilting said arms, as and for the purpose set forth.

14. In an electric furnace, a furnace-chamber, an electrode, a support therefor, suitably-journaled sleeves carrying plates, angle-arms carried by said plates, bearings respectively mounted upon said sleeves and arms and arranged to respectively engage said support on opposite sides to form bearings therefor, and means for rotarily adjusting said sleeves to tilt said support, as and for the purpose set forth.

15. In an electric furnace, a furnace-chamber, an electrode, a support therefor provided with a rack extending longitudinally thereof, a transversely-journaled shaft carrying a pinion engaging said rack, a sleeve mounted upon said shaft and carrying bearing-points arranged to embrace and engage said support, and means for independently rotating said shaft and sleeve, as and for the purpose set forth.

16. In an electric furnace, a furnace-chamber, an electrode, a support therefor, bearings arranged to embrace and maintain said support, a shaft upon which said bearings are mounted, journal-boxes for said shaft, and means for laterally adjusting said journal-boxes, as and for the purpose set forth.

17. In an electric furnace, a hopper or casing, a furnace-chamber communicating therewith, an electrode, a support therefor, a shaft transversely journaled in said hopper or casing and carrying bearing-arms arranged to embrace and maintain said support, slide-

boxes in which said shaft is mounted, and means for adjusting said slide-boxes, as and for the purpose set forth.

18. In an electric furnace, a hopper or casing provided with a smoke-stack, a furnace-chamber, an electrode supported in said hopper or casing and projecting into said chamber, a support for said electrode, means for adjusting the inclination of said support with reference to said chamber, said support having an offset or bend in the length thereof whereby clearance is left for the stack, as and for the purpose set forth.

19. In an electric furnace, a hopper or casing, a furnace-chamber communicating therewith, an electrode, a support therefor, said hopper or casing provided with a slot or opening through which said support projects, a slide-guide for said support, and means for adjusting the position of said support, as and for the purpose set forth.

20. In an electric furnace, a hopper, a furnace-chamber, an electrode, a support for said electrode, said hopper provided with a slot, a slide-guide mounted to move along said slot, a bearing-block journaled in said slide-guide, said support operating loosely through said bearing-block, and means for adjusting said support, as and for the purpose set forth.

21. In an electric furnace, a hopper having a slot or opening therethrough, a furnace-chamber, an electrode, a support for the latter, said support projecting through said slot or opening, means for adjusting said support, and means operated by the movement of said support into adjusted position for constantly maintaining said slot or opening closed, as and for the purpose set forth.

22. In an electric furnace, a hopper having a slot or opening therethrough, a furnace-chamber, an electrode, a support for the latter, a slide-guide arranged to move along the slot or opening in said hopper and adapted to receive said support loosely therethrough, means for adjusting said support, and a flexible cover connected to said slide-guide and operating to close said slot or opening in whatever position said support is shifted or adjusted, as and for the purpose set forth.

23. In an electric furnace, an electrode, a support therefor, a shaft, said holder bearing upon said shaft, plates mounted upon said shaft and each having arms arranged to extend beyond said holder, the arms of one plate being connected to the arms of the other in position to form additional bearings upon the opposite side or face of said holder, and means for turning the shaft to adjust the same rotarily, as and for the purpose set forth.

24. In an electric furnace, an electrode, a support therefor, a shaft having rollers mounted thereon and arranged to form a bearing for one side of said holder, arms carried by said shaft arranged to project beyond the other side of such holder to form additional bearings therefor, said arms carrying bearing-rollers, and means positively acting on said arms for tilting the same, as and for the purpose set forth.

25. In an electric furnace, an upper portion or casing having supports for a pair of electrodes, a furnace-chamber laterally removable from beneath the casing, a pressure device for elevating said member against the casing, and mean for withdrawing the electrodes out of said furnace-chamber to facilitate its removal, as and for the purpose set forth.

26. In an electric furnace, an upper portion or casing having a pair of electrodes, a lower member or furnace-chamber into which said electrodes project, and mechanism wholly inclosed within said casing for adjusting said electrodes, as and for the purpose set forth.

27. In an electric furnace, an upper portion or casing having a pair of electrodes, a lower member or furnace-chamber into which said electrodes project, and mechanism wholly included within the casing and operated by shafts extending through the walls thereof for adjusting said electrodes, as and for the purpose set forth.

28. In an electric furnace, an upper portion or casing having a pair of electrodes, a lower member or furnace-chamber into which said electrodes project, and mechanism wholly included within the casing and operated by concentric shafts extending through the walls thereof for adjusting said electrodes, as and for the purpose set forth.

29. In an electric furnace, an upper portion or casing having a pair of electrodes, a lower member or furnace-chamber into which said electrodes project, and mechanism operated by concentric shafts for tilting and adjusting said electrodes, as and for the purpose set forth.

30. In an electric furnace, an upper portion or casing having a pair of electrodes, a lower member or furnace-chamber into which said electrodes project, and mechanism operated by concentric shafts for tilting and adjusting said electrodes longitudinally and rotarily, as and for the purpose set forth.

31. In an electric furnace, an upper portion or casing having a pair of electrodes, a lower member or furnace-chamber into which said electrodes project, mechanism operated by concentric shafts for adjusting said electrodes, and means for laterally adjusting said shafts, as and for the purpose set forth.

32. In an electric furnace, an upper portion or casing having a pair of electrodes, a lower member or furnace-chamber into which said electrodes project, and mechanism disposed within the casing and adjustable laterally whereby the electrodes may be shifted into a substantially vertical position, as and for the purpose set forth.

33. In an electric furnace, a casing, a pair of electrodes, an opening in the casing through which portions of an electrode project, and means for closing the space of said opening which is not occupied by said electrode, as and for the purpose set forth.

34. In an electric furnace, a pair of electrodes, and mechanism for laterally, longitudinally and rotarily adjusting the same, as and for the purpose set forth.

35. In an electric furnace, a pair of electrodes, and mechanism included within the casing for laterally, longitudially and rotarily adjusting the same, as and for the purpose set forth.

36. In an electric furnace, a melting-pot, an enlarged casing above the same, electrodes included within the casing, and mechanism for adjusting said electrodes arranged in offset relation with respect thereto, whereby said electrodes may be shifted into a substantially vertical position adjacent to one another, as and for the purpose set forth.

37. In an electric furnace, an upper portion or casing having a stack, and a pair of electrodes, a lower member or chamber into which said electrodes project, supports having laterally-offset portions, the electrodes being mounted on said laterally-offset portions, whereby a movement of the supports into proximity to the stack moves the electrodes into proximity to each other, as and for the purpose set forth.

38. In an electric furnace, an upper portion or casing, a lower member or furnace-chamber removably located beneath said casing and having discharge-openings in the side thereof, a complete system of electrodes all supported entirely from the upper casing and out of contact with the lower casing, and a truck for laterally removing said furnace-chamber, as and for the purpose set forth.

In witness whereof I have hereunto set my hand, this 19th day of July, 1902, in the presence of the subscribing witnesses.

HERMAN L. HARTENSTEIN.

Witnesses:
E. C. SEMPLE,
S. E. DARBY.