(No Model.)

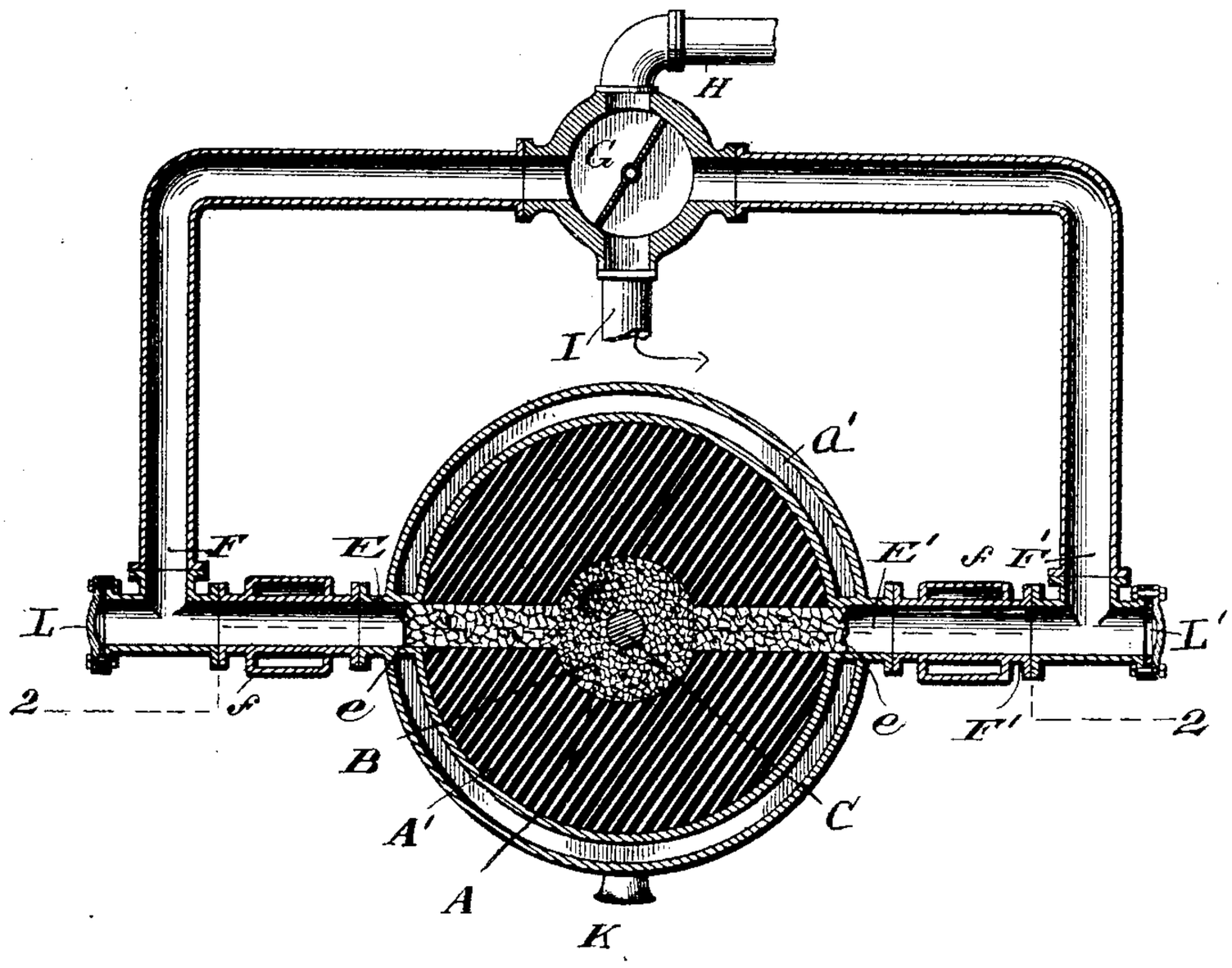
2 Sheets—Sheet 1.

A. H. COWLES.

ELECTRIC FURNACE.

No. 583,250. Patented May 25, 1897.

Fig. 1.



Witnesses
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Oliver St. Bailey.

Inventor
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By Sidney B. Lord,
his Attorney.

(No Model.) 2 Sheets—Sheet 2.

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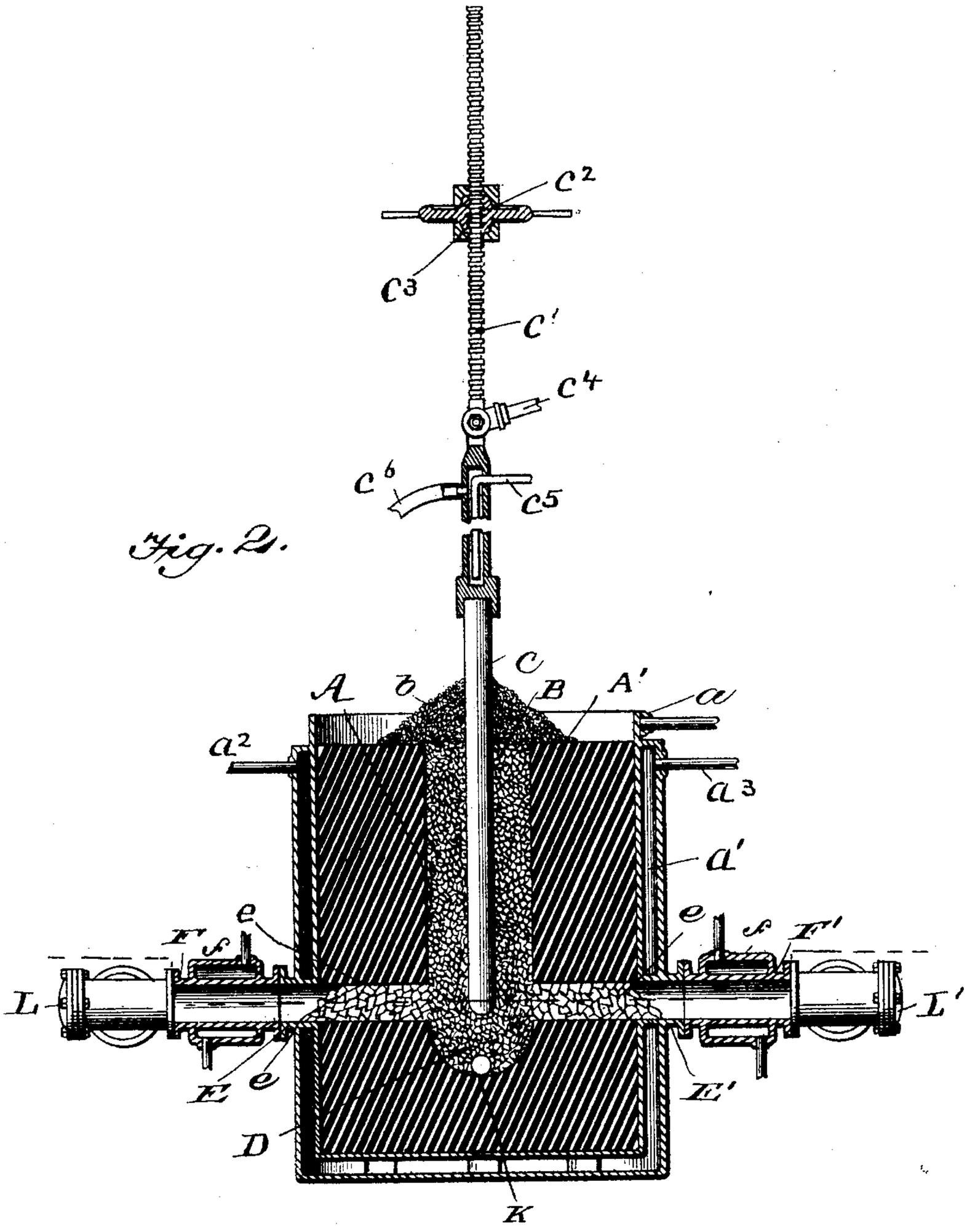

Fig. 2.

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UNITED STATES PATENT OFFICE.

ALFRED H. COWLES, OF CLEVELAND, OHIO, ASSIGNOR TO THE ELECTRIC SMELTING AND ALUMINUM COMPANY, OF ILLINOIS.

ELECTRIC FURNACE.

SPECIFICATION forming part of Letters Patent No. 583,250, dated May 25, 1897.

Application filed July 6, 1895. Serial No. 555,116. (No model.)

To all whom it may concern:

Be it known that I, ALFRED H. COWLES, a citizen of the United States, residing at Cleveland, in the county of Cuyahoga and State of Ohio, have invented certain new and useful improvements in electric furnaces and electrically-heated apparatus and in methods of operating the same and controlling the field of heat; and I do hereby declare the following to be a full, clear, and exact description of the invention, such as will enable others skilled in the art to which it appertains to make and use the same.

The object of the present invention is to provide an electric furnace or apparatus into which a gas is passed, and a method of operating such a furnace, which shall admit of economical results being obtained that have not heretofore been possible.

The admission of gas or of a gas or vapor producing fluid into an electric furnace has heretofore been practiced, but the gas or the fluid has always been introduced through a single inlet-pipe or in a uniform direction, and likewise, where specific means have been provided for the discharge of gas from the furnace or chamber, it has been taken off through an outlet pipe or passage, and always at the same point of discharge. Further, the flow or course of the gas through the furnace-chamber, or through or over electrically-heated material or surfaces therein, or of a gas-generating fluid which vaporizes on entering the furnace or chamber and then passes as gas therethrough, has always been constant whenever it has been given any direction, and hence the effect of the steady outflow of gas from the furnace-chamber or through a mass of material through which the gas passes tends to excessively heat the furnace or the body of material on the side of or in the vicinity of the line of discharge, and also the gas carries with it and deposits on the discharge side, or in the interstices of the mass along the lines of flow toward the point of disharge, soot, dust, and fine particles which clog the interstices and interfere with the obtaining of the best results. Suppose, for example, we have a body of granular or broken carbon, carbon and ore, or other material with a field of intense heat in the center of the mass evolving gases which must find a vent, or suppose in such a case a stream of gas is being injected into the mass, which gas passes through the zone of heat and then passes out, the gases flowing outward from the heated area are at a very high temperature and gradually heat up the mass adjacent to its path of outflow, gradually extending the field of intense heat farther and farther from the central zone in the direction of the outlet, until along this line of flow the temperature of the mass approximates to the temperature of the central field, while on the inflowing side of the field the temperature of the mass is relatively low. Likewise, if we have an electrically-heated open chamber through which there is a flow of gas, or an electrically-heated surface or series of surfaces within an inclosure, over which surfaces there is a flow of gas in a constant direction, the hot gases heat up the discharge side of the inclosure or the avenues of exit far above the temperature of other parts of the chamber away from the zone of high heat, and, as before stated, particularly in the case where there is an interstitial means through which the gas flows within the chamber or immediately after leaving it, the particles of soot, dust, or sublimated matter carried outward from the zone of heat by the outflowing gas are deposited to a greater or less degree as soot, dust, or an amorphous or crystalline powder along the avenues of flow and clog the passages. In the case of a granular mass, or a granular mass mixed with fine material, or a mass of finely-divided ore and other material electrically heated at the center with gas working outward therefrom to the surface, in some cases little mounds with craters are formed at the points of outlet with the intensely-heated area extending from the center along the path of outflow close up to the crater. This action of the outward extension of the field of heat along the lines of exit of the gases from the center of a granular mass is clearly shown in the working of an electric furnace of the type disclosed in the early patents granted to myself and Eugene H. Cowles—as, for example, No. 319,795, of June 9, 1885, and No. 324,658, of August 18, 1885—

wherein there is a body of granular material with a central zone of heat; nor is such effect entirely absent when there is coupled therewith an arc effect, as, for example, when the process of the last-named patent is carried on in a chamber on the principle of a Siemens arc-furnace, as set out in said later patent. Under the conditions ordinarily existing during the running of such furnaces, where there is a mass of fused ore and granular carbon forming a spongy or a thick pudding-like mass or an overlying layer of such a character, the gases work upward or outward to the surface along the channels of easiest passage and extend the central heat along such lines more rapidly than in other directions. The same effect is true where a gas has by reason of entering at a certain point and discharging at another fixed point an approximately constant line of flow through the mass or through the chamber.

It is the object of the present invention to control this field of heat and to effect a more uniform distribution or extension of the zone of area of intense heat and a more effective and uniform action on the gas passed therethrough, and this I secure by periodically or at times changing the direction of the course of the current of gas flowing into or through the chamber of an electric furnace, or over the electrically-heated surfaces, or through a mass or body of electrically-heated matter, so that the course of the hot gases leaving the heated area or center will be changed.

This improvement is specially directed to the treatment of a gas for the production of an illuminating or a heating gas, or to the utilization for illuminating, heating, or other purposes of the waste gases of an electric furnace.

As an illustration of the principle of the invention and its effects, I will illustrate and describe it in connection with an interstitial mass in an electric furnace through which there is flowing a stream of gas, though it will be understood that it is not limited to the specific conditions here existing, but applies to any electrically-heated chamber, surface, or mass through or over which there is caused to pass a current of gas or a current of gas-producing materials.

Figure 1 is a vertical section view of an electric furnace, and Fig. 2 is a longitudinal sectional view of the same on the line 2 2.

A is a furnace-chamber filled with a charge B of granular or broken coke, for example, or other suitable material, it matters not what, and C is an electrode leading down into the mass, the bottom of the furnace-chamber forming the other electrode. This electrode is adjustably supported in any preferred way. For example, the upper end C' of the holder is screw-threaded and engages with a hand-wheel nut C^2, properly supported in a girder C^3. One of the electric cables is attached to the holder at C^4. Provision is made for cooling the carbon-holder by means of a flow of water therethrough. The lower part of the holder is made hollow and provided with a water-pipe C^5, leading into the bottom of the hollow chamber within the rod, and with a water-discharge pipe C^6 at the upper end of the same. The furnace-chamber or crucible is also provided with a water-jacket a' and with water-pipes a^2 a^3 for the inflow and outflow of water therefrom. Electrical connection is shown as made with the outer iron shell of the furnace at a, the current passing through the carbon filling or block A' to the charge in the furnace-chamber. Extending laterally from opposite sides of the furnace-chamber and a sufficient distance above the bottom of the same to form a sump D below there are the lateral flues, passages, or pipes E E', diametrically opposite and leading outward through the furnace-walls and filled with coarsely granulated or broken carbon or coke e, the interstices of the same forming carbon-lined passages for the gas. These interstices in the bodies of broken carbon flanking the furnace-chamber form on each side thereof a group of flues or channels through which the gas has to pass on entering and leaving the chamber, and the mass being of carbon the channels have surfaces or linings which are able to withstand the extremely high heat, and the flues remain open. Carbon is the only material available which will stand the high temperature to which these channels are subjected without fusing or running. The passages through the interstitial bodies of carbon are as efficient flues for gas-flow as those formed with straight or regular walls. Connected with these flues E E' are the gas-pipes F F', respectively, properly protected by water-jackets f f, said gas-pipes leading into the reversing valve-chamber G, which chamber has a gas-supply pipe H and a gas-discharge pipe I, which may, for example, lead to a gasometer or to such apparatus as may be proper for the subsequent treatment or handling of the product.

The furnace-chamber is indicated as filled to the top with coarse and fine carbon, and if the charge is covered over with a surface covering of fine carbon b it is a sufficient closing in of the furnace-chamber for the treatment of gases under light pressures. The chamber may, however, be completely closed in and sealed or luted.

K is a tap-hole for drawing off any molten material accumulating in the sump.

In operation the furnace having been heated up to the point where the temperature of the interior of the carbon charge or mass in the chamber is high enough for working the gas is admitted through one of the pipes—F E, for example—and, passing through the interstices of the carbon body B and through the central field of heat where the chemical change in the gas takes place or the major portion of the same is effected, that being the field of the greatest electrical energy, it flows outward through the passage E' and the in-

terstices of the carbon *e*, filling the same in the present case, and through the pipe F′ and the proper channel in the reversing-valve G and the discharge-pipe I. The heated gas passing through the central intensely-heated field to and through the flue E′ gradually extends the field of heat in the direction of this point of exit, while the inflowing current of gas cools the opposite side of the chamber and gradually works the edge of the sphere or zone of heat inward toward the center of the mass. The center of the zone of highest heat, barring an arc center, by reason of the carrying inward of the heat on the inflowing side and the carrying outward of heat on the outflowing side, is thus being gradually moved toward the point of exit of the gas from the chamber. The particles of soot, dust, and sublimated matter picked up and carried along by the gas-currents are on the inflowing side carried inward toward the center of greatest electrical activity and the region most favorable for the chemical changes, thus clearing out and opening up the channels for the free passage of the gas through the mass on that side, while on the side of exit the gas-currents as they get away from the heating field deposit within the interstices of the mass and of the exit-passage the dust, soot, and sublimated powders carried by them. After the gas has been flowing through the furnace for a proper interval of time the reversing-valve G is shifted, making connection of the gas-supply pipe H with the pipe F′ and of the pipe F with the gas-discharge pipe I. The flow of gas is now through the furnace-chamber from the flue E′ to the flue E in the opposite direction from what it had been flowing and in an opposite direction through the interstices of the carbon charge B in the furnace. The effects above set out now occur in an opposite direction. The area of intense heat which extended laterally toward the flue E′ now moves inward and travels toward the new point of exit, the flue E, and the deposited fine matter in the interstices of the mass is carried back into the heated field, while the formation of new deposits in the interstices of the mass on the opposite side and in the flue E may be forming.

Thus with a proper periodical reversal of the gas-valve it will be seen that there is secured a perfect control of the field of heat in the furnace and it can either be held central by making the reversals of the flow sufficiently frequent or it can be caused to move to and fro. This movement of the field of heat is the most marked in an incandescent mass where there is no fixed arc center. It may be assumed that the heat can then be bunched and the center of greatest heat moved along the line of the flow of the gas through the mass to the point of exit and then caused to travel back again and to and fro.

The salient feature of this invention has other applications than those herein described for the securing of effects in the treatment of other material than gas and aeriform fluids, as will appear by reference to an application of even date herewith, Serial No. 555,115, and reference is also made to the prior application of date February 27, 1889, Serial No. 301,377, wherein, in part, the water cooling of an electric furnace is a feature of the application; but

What I do herein claim as my invention is—

1. In an electric heating apparatus, the combination with a chamber, of an electric circuit connected therewith and adapted to produce a zone or area of electric heat, separate gas inlet and outlet passages connected with said chamber, and means for periodically reversing the flow of gas therethrough, as and for the purpose set forth.

2. In an electric furnace, the combination with a furnace-chamber of an electric circuit connected therewith and adapted to create a zone of electrical heat within the furnace-chamber, of separate inlet and outlet gas-flues and interstitial bodies in the path of the inflowing and outflowing gases, together with means for reversing the flow of gas therethrough, as and for the purpose set forth.

3. In an electric furnace, the combination with a furnace-chamber of an electric circuit connected therewith and adapted to create a zone of electrical heat within the furnace-chamber, of inlet and outlet gas-flues, and interstitial bodies contiguous to the zone of electrical heat and in the path of the inflowing and outflowing gases, together with means for reversing the flow of gas therethrough, as and for the purpose set forth.

4. The combination with an electric furnace-chamber of lateral apartments filled with broken carbon and forming gas-passages for the inflow and outflow of gas, in combination with gas-pipes connected with said apartments, and a reversing-valve to control the direction of the flow of gas through the furnace, as and for the purpose set forth.

5. In an electric furnace or apparatus, in which there is a field, zone or area of electric heat, with means for passing a gas therethrough, bodies of carbon on opposite sides of the field or zone of electric heat, with interstices or channels through the said bodies for the flow of gas therethrough, and means for reversing the flow of gas through the same, as and for the purpose set forth.

6. A furnace and furnace-chamber, having carbon-lined flues or channels extending outward therefrom, and adapted to forming gas-passages for the flow of gas to and from the furnace-chamber, together with means for directing the flow of gas, in through one group of carbon-lined flues or channels to the furnace-chamber, and out through another group of the same, and a reversing-valve, for directing the flow of the gas, as and for the purpose set forth.

7. The combination with a furnace-chamber of outwardly-extending flues filled with broken carbon, and forming gas-passages for

the inflow and outflow of the gas or gases, in combination with gas-pipes connected with said flues, and a reversing-valve to control the direction of flow of the gas through the furnace, as and for the purpose set forth.

8. In an electric furnace a furnace-chamber having outwardly-extending gas-flues, diametrically opposite and filled with granulated or broken carbon, with gas-pipes connected with said flues, and a reversing-valve to control the direction of the flow of the gas through the furnace, as and for the purpose set forth.

In testimony whereof I hereto affix my signature in presence of two witnesses.

ALFRED H. COWLES.

Witnesses:
CHAS. M. VORCE,
WM. G. TAYLOR.