No. 629,008. Patented July 18, 1899.

O. FRÖLICH.

APPARATUS FOR DISTILLING METALS OR SIMILAR SUBSTANCES.

(Application filed Sept. 27, 1898.)

(No Model.)

Fig. 1.

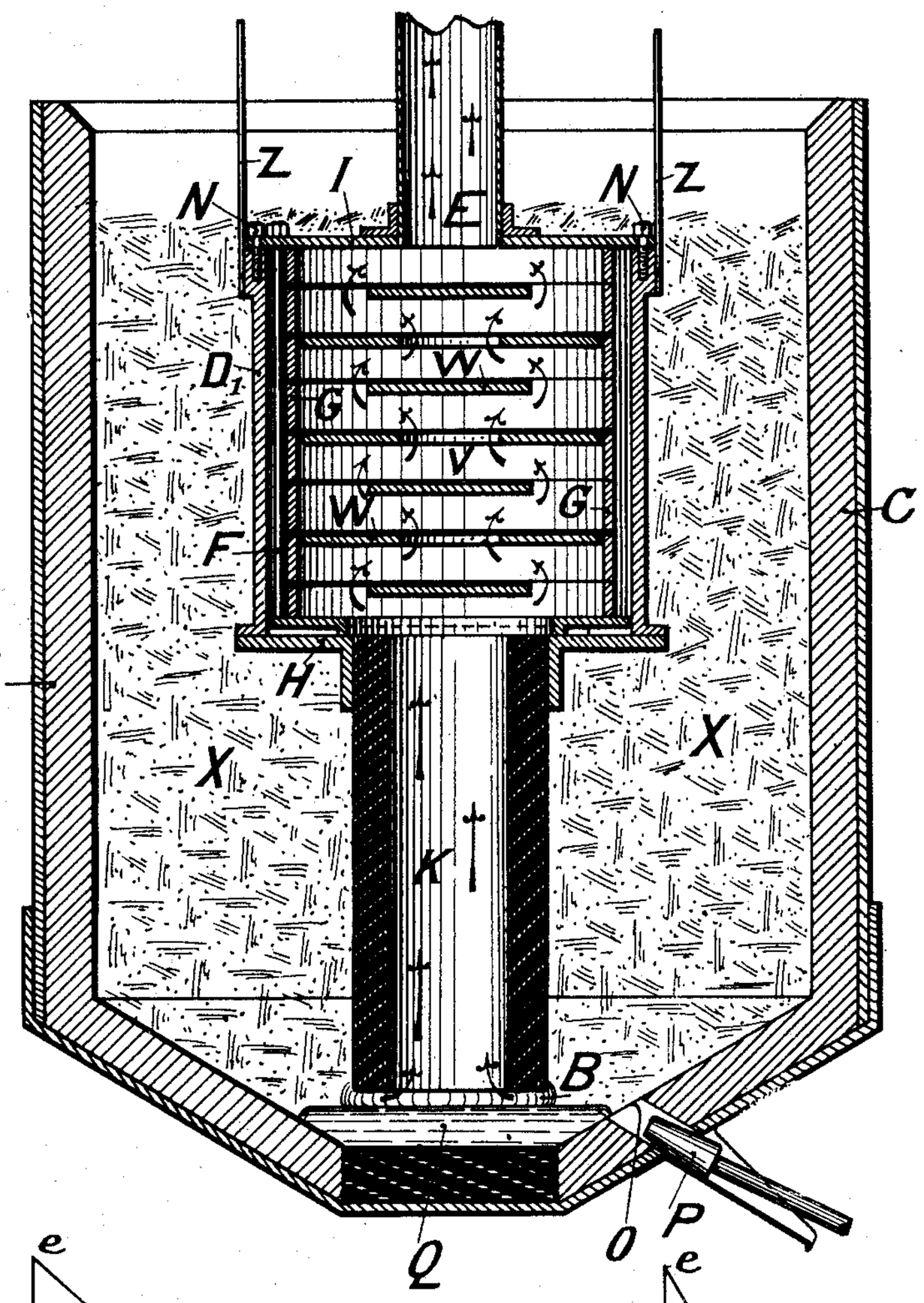


Fig. 2.

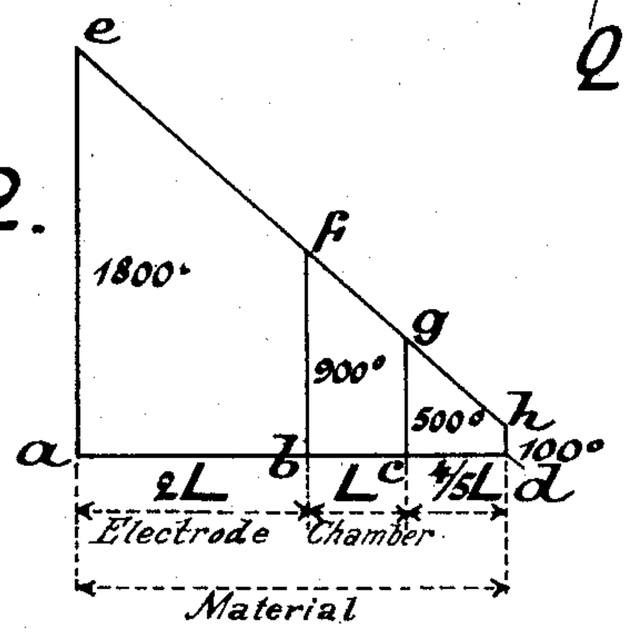
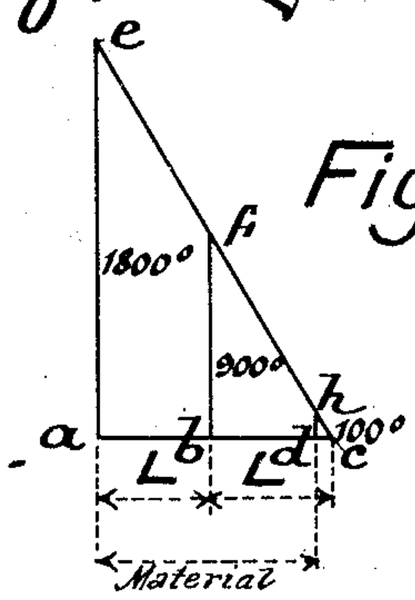


Fig. 3.



WITNESSES:

D. N. C. Sanner.

A. D. Lawrence.

INVENTOR:

Oscar Frölich,

By Barton Brown

Attorneys.

UNITED STATES PATENT OFFICE.

OSCAR FRÖLICH, OF STEGLITZ, GERMANY, ASSIGNOR TO SIEMENS & HALSKE AKTIEN-GESELLSCHAFT, OF BERLIN, GERMANY.

APPARATUS FOR DISTILLING METALS OR SIMILAR SUBSTANCES.

SPECIFICATION forming part of Letters Patent No. 629,008, dated July 18, 1899.

Application filed September 27, 1898. Serial No. 691,975. (No model.)

To all whom it may concern:

Be it known that I, OSCAR FRÖLICH, a citizen of the Swiss Republic, residing at Steglitz, near Berlin, German Empire, have invented a certain new and useful Improvement in Apparatus for Distilling Metals or Similar Substances, (Case No. 2,) of which the following is a full, clear, concise, and exact description.

The herein-described invention relates to an improved apparatus for distilling metals and other substances that ought not to be cooled below a certain comparatively high temperature before being condensed. I desire that reference be had in this connection to my application, Serial No. 691,974, filed September 27, 1898.

The invention as herein illustrated consists of an electric furnace containing a thick layer of the raw material that is to be subjected to distillation and provided with a condensing-chamber that is adapted to be buried in said material, and thereby to be maintained at the desired high temperature.

Of the accompanying drawings, Figure 1 is a vertical section showing the herein-described arrangement, and Figs. 2 and 3 are diagrams.

In Fig. 1, C is an iron box or crucible lined with carbon and serving as one electrode of an electric furnace. K is the carbon serving as the other electrode of the furnace and being made in the shape of a tube. The carbon tube K is fixed at its upper end in an iron flange H, which at the same time forms the bottom of the condensing-chamber V. The latter consists of the wide tube D′, preferably also made of iron and closed at the bottom by the flange H and at the top by the lid I. The flange H, the sides D′, and the lid I are held together by rods F and screws N N.

Between the lid I and the bottom H of the condensing-chamber are inserted a number of ring-pieces G, each of which is provided with a disk W. These disks are provided with holes or perforations alternately placed in the center and at the edge of the disk, thereby forcing the gaseous products to take a meandering course as they proceed through the condensing-chamber V, as indicated by arrows. In the center of the lid I a pipe E, preferably likewise made of iron, is tightly fitted, which is adapted to carry off the gaseous products passing through the condensing-chamber without being condensed. The whole arrangement, consisting of the pipe E, the condensing-chamber V, and the carbon K, is suspended from the rods Z and can be raised and lowered thereby for the purpose of regulating the arc formed at B between the carbon K and the fused part of the material Q.

The opening O and plug P serve to tap off the fused material Q when a sufficient quantity has collected.

In many cases—for instance, in the distillation of zinc—it is necessary to maintain the condensing-chamber at a comparatively high temperature, because when the chamber is too cold the products of distillation will be precipitated before entering it, and when it is too hot they will pass through it without being condensed. For this purpose it was necessary in similar arrangements hitherto in use to provide special means for heating the condensing-chamber while the distillation was going on. With my arrangement this necessity is avoided and the heat of the distilling-furnace itself is utilized for this purpose.

If the material that is to be subjected to distillation is thoroughly pulverized and mixed, so as to form a nearly homogeneous mass, the heat generated by the electric arc at B will be equally propagated through the whole mass, according to the ordinary laws of convection of heat. Now since the temperature of the air just above the surface of the layer of material X will during the operation maintain a practically constant temperature, the temperature at the surface of the heap of material X will likewise remain practically constant, though the actual height of the said heap may vary considerably, and the variation of the temperature in the material will decrease from the arc at B toward the surface according to a linear function. This circumstance is made use of in my apparatus, as will be understood by reference to the diagrams Figs. 2 and 3. The temperatures indicated in these two diagrams are given in degrees

centigrade and refer to the distillation of zinc by way of an example. In the distillation of zinc the temperature of the condensing-chamber ought to be maintained at a temperature varying from the inlet of the zinc vapors to the outlet of the same between the temperatures of 900° and something below 500° centigrade.

In the diagrams the line *a d* designates the height of the heap of pulverized material X in the crucible from B to the surface. The vertical lines *a e*, *b f*, *c g*, and *d h* are temperatures, and the line *e f q h* represents the linear fall of the temperature from the point B to the surface of the heap X. The length L of the line *b c* is meant to indicate the height of the condensing-chamber V. It is assumed that temperature of the material at B is 1,800° and that at the beginning of the operation the length of the carbon tube is 2 L or double the height of the condensing-chamber V. Then it will be seen from the diagram that the length of *a d* ought to be made equal to 3.8 L in order to maintain the temperature at 900° at *b* and at 500° at *c*, or, in other words, the material ought to be heaped up to 0.8 of the height of the condensing-chamber V above the lid I of the latter. As the carbon is consumed the height of the heap of material should be likewise diminished, so as to always maintain the temperature at *b* at the aforesaid height of 900°.

In the diagram Fig. 3 it is assumed that the length of the carbon has been reduced to L or one-half of its original value. In order to maintain the predetermined temperature of 900° at *b*, it will be seen that the height of the heap of material must be reduced to 1.9 L or to 0.9 of the height of the condensing-chamber, counting from the flange H. The temperature will then be 900° at the inlet of the vapors into the condensing-chamber and something approaching 100° at the outlet.

In order to operate my improved apparatus, I proceed as follows: The material that is to be worked is pulverized to a sufficient fineness, is thoroughly mixed, and is continuously fed into the upper opening of the crucible C. The arc is started, and as the operation proceeds the feeding in of fresh material is regulated in such a way, according to the rules given above, as to maintain at the inlet of the condensing-chamber the desired temperature. I have found by experiment that the pulverized material efficiently excludes the atmospheric air from the arc and at the same time prevents the vapors forming in the furnace at B from escaping outside the carbon tube K. They are thus forced to pass through the condensing-chamber, and when the latter is sufficiently filled with the precipitate it is removed and the ring-pieces G and disks W are replaced by others from which the precipitate obtained from previous operations has been collected. The non-condensable gaseous products escape through the tube E.

In the above description I have restricted myself to explaining the operation of my apparatus with reference to the distillation of zinc; but I desire it to be understood that I do not limit the application of this apparatus to the production of this metal, since it will be readily seen that by judiciously regulating the height of the layer of material X the same regulation of temperatures may be obtained for other absolute values as those assumed in the above example without exceeding the scope of my herein-described invention.

Having now described apparatus embodying my invention, I claim as new, and desire to secure by these Letters Patent, the following:

1. In a furnace of the class described, the combination with a crucible adapted to receive the treated material, of a movable tubular carbon electrode, a condensing-chamber connected with the opening in the said electrode, and means provided within the chamber for retaining the condensed products of the furnace, the said electrode and condensing-chamber being mounted within the crucible and constructed to receive the treated material between their side walls and those of the crucible, substantially as described.

2. In an electric furnace consisting of a crucible open at the top and closed at the bottom by a tapping-plug, a condensing-chamber, a tube-shaped carbon the interior of which communicates with the interior of the condensing-chamber said condensing-chamber being fastened to the upper end of said carbon and provided with a pipe at its top likewise communicating with its interior, said condensing-chamber being fitted with a number of horizontal partitions alternately perforated at the edges and in the center substantially as and for the purpose described.

3. In an electric furnace consisting of a crucible open at the top and closed by a removable tapping-plug at the bottom a tube-shaped upper electrode made of carbon and fixed at the lower end of a condensing-chamber and communicating with the interior of said chamber the said chamber being provided with a suitable number of horizontal partitions which are arranged to be removed when it is filled with precipitate, substantially as and for the purpose set forth.

4. In a distilling electric furnace, the combination with a crucible adapted to receive the treated material, of a tubular carbon electrode movably mounted therein, a condensing-chamber disposed above the opening in said electrode, removable parts provided in the said chamber for retaining the condensed products, the said electrode and condensing-chamber being centrally disposed within the crucible about which electrode an envelop of treated material of variable height is adapted to be inserted and replenished, the said material lying between the side walls of the crucible and electrode, whereby the gases and

distilled products are directed interiorly from the electrode to the condensing-chamber, substantially as described.

5. In an electric furnace for distilling metals or similar substances, the combination with a crucible forming one electrode, of a tubular upper carbon electrode movably disposed therein, and a condensing-chamber provided with means for collecting the condensed product, the said chamber communicating with the tubular carbon electrode, the said furnace being constructed to receive a deep layer of pulverized raw material surrounding the said carbon electrode within the crucible, substantially as and for the purpose set forth.

6. In an electric furnace for distilling metals or other similar substances, the combination with a crucible forming one electrode, of a tubular upper carbon electrode movably disposed therein, and a condensing-chamber communicating therewith, provided with a plurality of partitions alternately perforated at the edges and in the center, the said furnace being constructed to receive a deep layer of pulverized raw material surrounding the said electrode within the crucible, substantially as and for the purpose set forth.

7. In an electric furnace for distilling metals or other similar substances, the combination with a crucible forming one electrode, of a tubular upper carbon movably disposed therein, a condensing-chamber communicating with the opening in the carbon electrode, and a plurality of removable perforated partitions disposed within the condensing-chamber, the said furnace being constructed to receive a deep layer of pulverized raw material surrounding the carbon electrode within the crucible, substantially as and for the purpose set forth.

In witness whereof I have hereunto subscribed my name this 6th day of September, A. D. 1898.

OSCAR FRÖLICH.

Witnesses:
C. H. DAY,
HENRY HASPER.