No. 773,821. PATENTED NOV. 1, 1904.

C. P. STEINMETZ.

ELECTRIC FURNACE.

APPLICATION FILED MAY 24, 1900.

NO MODEL.

Fig. 1.

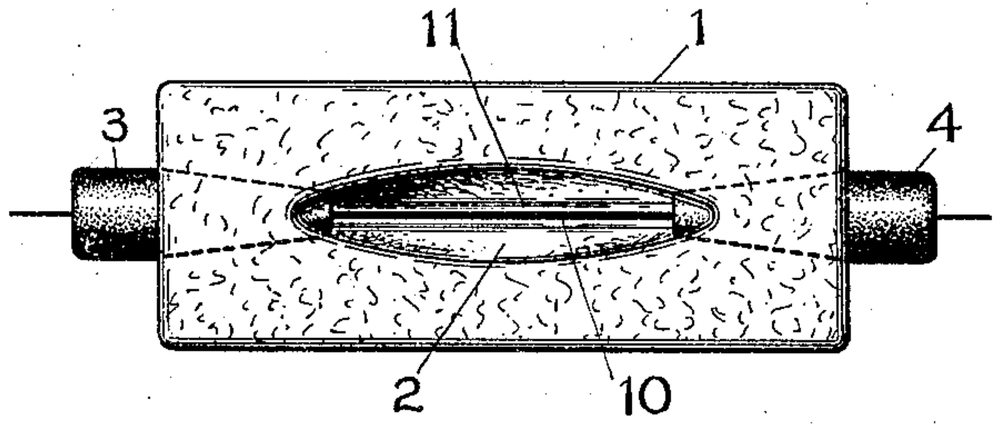
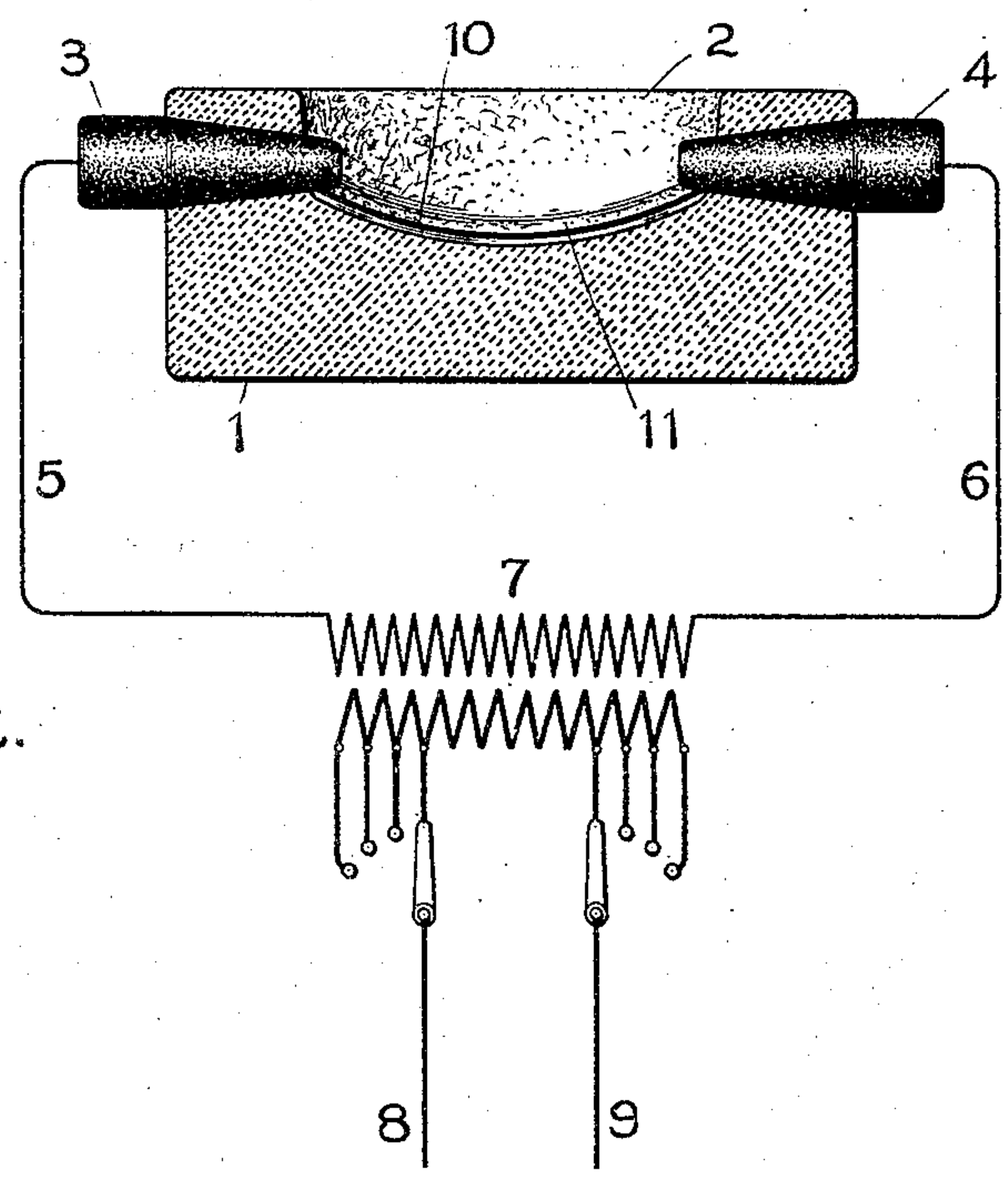


Fig. 2.



Witnesses:
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No. 773,821. Patented November 1, 1904.

UNITED STATES PATENT OFFICE.

CHARLES P. STEINMETZ, OF SCHENECTADY, NEW YORK, ASSIGNOR TO THE GENERAL ELECTRIC COMPANY, A CORPORATION OF NEW YORK.

ELECTRIC FURNACE.

SPECIFICATION forming part of Letters Patent No. 773,821, dated November 1, 1904.

Application filed May 24, 1900. Serial No. 17,834. (No model.)

To all whom it may concern:

Be it known that I, CHARLES P. STEINMETZ, a citizen of the United States, residing at Schenectady, county of Schenectady, State of New York, have invented certain new and useful Improvements in Electric Furnaces, of which the following is a specification.

My invention relates to the art of electric heating, and comprises certain novel means for producing and controlling temperatures lying within the range above the maximum temperature available by combustion and below that of the electric arc.

In carrying out my invention I make use of the fact that many refractory materials—such, for example, as refractory oxids, silicates, wolframates, chromates, &c.—are of comparatively high resistance at ordinary temperatures, but increase in conductivity when heated, their conductivity increasing with the temperature. Such conductors I designate by the term "pyroelectrolytes." By exposing such pyroelectrolytes to a difference of potential and heating them by some means to a suitable temperature they become conducting, whereupon current commences to flow, giving rise to heat, the degree of which may be regulated or maintained at any desired point by correspondingly regulating the amount of energy expended in heating the pyroelectrolyte. The temperature at which these substances become conducting depends upon the substance, some requiring very high temperatures—as, for example, the pure oxids—while others, as the alkali silicates, become conducting at comparatively low temperatures. In making use of this feature for the purposes of electric heating I expose the substance to be heated, either directly or inclosed in a vessel of very refractory material, to the heat generated in a mass of some chosen pyroelectrolyte.

In its practical application my invention is capable of numerous modifications; but for the present purpose I consider it unnecessary to describe more than one useful means for carrying it into operation.

The particular means which I employ will better be understood by reference to the following description, taken in connection with the accompanying drawings, while its novel features will be particularly pointed out in claims appended hereto.

In the drawings, Figure 1 is a plan view of an electric furnace, and Fig. 2 is a sectional view of the same.

Where comparatively small quantities of material are to be heated, I find it convenient to make the furnace out of a block or blocks of pyroelectrolytic material either hollowed out or formed with a depression for containing the substance to be acted upon. In the particular arrangement shown in the drawings a block of pyroelectrolytic material is indicated at 1 and is provided with a depression having a horizontal section approximately elliptical, such as is indicated at 2, the depth of the depression being greater at the middle portion than at the ends, as will be readily seen in Fig. 2.

The terminals through which the electric current is conducted to the furnace consists of some suitable material—such, for example, as carbon—formed into blocks fitted into openings communicating with the retaining recess or cavity for the material to be heated. The carbon terminals are indicated at 3 and 4 and are conical in shape and engage with corresponding openings in the opposing ends of the block 1 of pyroelectrolytic material. Current is transmitted to the terminals 3 4 by a suitable conducting-circuit (indicated diagrammatically by the lines 5 6) connected in series with the secondary 7 of a step-up transformer. The primary of the transformer has its winding subdivided, so that either a greater or a less portion of its length may be included in circuit with the primary supply-mains 8 9, thereby offering a means for varying the electromotive force impressed upon the terminals of the furnace. I have indicated this means for varying the electromotive force, and consequently the current supplied to the furnace, merely by way of illustration, and it will be evident that any other suitable and appropriate means for performing this function may be employed without departing from my invention.

As has already been stated, the pyroelectrolytic material forming the walls of the furnace is practically a non-conductor when cold, so that in order to cause current to flow through the same it is necessary that some means for initially heating the same should be provided. There are various arrangements which are suitable for this purpose. Thus, for example, heat may be applied to the furnace-walls from some external source—as, for example, by means of a blowpipe or some similar source of intense heat. I find it convenient, however, to produce the initial heating of the pyroelectrolyte by arranging some refractory conducting material between the terminals of the furnace and either close to or embedded in the pyroelectrolyte. In the drawings I have shown a small rod or filament 10 of carbon extending between the terminals 3 4 and embedded within a recess 11 in the bottom of the cavity 2.

In starting the furnace a suitable difference of potential is impressed upon its terminals, thereby heating the filament 10, and so communicating heat to the adjacent pyroelectrolyte, which thereupon becomes conducting, and current from the source commences to flow through the same, giving rise to a degree of heat determined by the difference of potential impressed upon the furnace.

In furnaces of this character the phenomena taking place are widely different from those occurring in methods of heating by the electric arc. In an arc-furnace—such, for example, as a carbid-furnace—the potential gradient or drop in voltage along the heated space is comparatively low as compared with the potential gradient or drop in voltage in a pyroelectrolyte heated by the electric current, the potential gradient in the carbid or similar furnace being of the magnitude of ten volts per inch as compared with one thousand volts per inch in the pyroelectrolytic furnace above described. This large potential gradient by giving rise to the possibility of a large expenditure of electric energy in a confined space explains the capability of the pyroelectrolytic furnace for producing extremely high temperatures.

By the operation of my invention temperatures can be produced and maintained from the relatively low temperature of fusible alkali silicates, as glass, up to the extremely high temperatures of fusible orthosilicates of alumina, &c., and chemical reactions produced at these temperatures.

A further application of my invention would be for melting refractory oxids and silicates, as those of alumina, &c. When melted in the arc, no clear and transparent products can be secured, since the temperature of the arc is beyond the boiling-point and at the dissociation temperature of these substances and the resulting mass thus filled with air-bubbles and partly dissociated. By raising to, however, and maintaining the temperature exactly at or slightly above the melting-point of these substances they can be fused satisfactorily.

Most precious stones—as topaz, sapphire, emerald, and ruby—are alumina or aluminium silicate more or less colored by foreign material. Others are oxid and silicate of beryllia and zirconia. I have thus found by experiment that by heating aluminium silicate by this means it fuses to a transparent mass, colored yellowish in the present instance by impurities and of the nature, hardness, and composition of topaz, and I have also succeeded by small traces of chromic oxid and cobaltic oxid in getting green and blue transparent masses of the nature of emerald and sapphire, while in other cases I have produced a red color.

What I claim as new, and desire to secure by Letters Patent of the United States, is—

1. An electric furnace having walls formed of a pyroelectrolyte and fashioned to receive and retain the substance to be acted upon, means for initially heating said pyroelectrolyte, and means for thereafter heating said electrolyte by the direct passage therethrough of electric current.

2. An electric furnace consisting of a mass of pyroelectrolytic material, terminals in operative relation thereto, and a refractory starting-conductor of relatively small cross-section extending between the terminals.

3. An electric furnace comprising a mass of pyroelectrolytic material fashioned to receive and retain the substance to be acted upon, terminals in operative relation to the furnace, and a source of current of high electromotive force connected to said terminals.

4. In an electric furnace, the combination of a mass of pyroelectrolytic material provided with a chamber to receive the material to be heated, terminals in operative relation to said mass of pyroelectrolytic material, a source of current of high electromotive force connected to said terminals, and means for varying said electromotive force and thereby varying the degree of heat produced in the furnace.

5. In an electric furnace, the combination of a mass of pyroelectrolytic material provided with a chamber to receive the material to be heated, terminals in operative relation to said mass of pyroelectrolytic material, means for initially heating said mass of pyroelectrolytic material so as to render the same conducting, a source of current connected to said terminals, and means for varying the amount of current supplied to said terminals thereby varying the degree of heat produced by the furnace.

In witness whereof I have hereunto set my hand this 22d day of May, 1900.

CHARLES P. STEINMETZ.

Witnesses:

BENJAMIN B. HULL,

MABEL H. EMERSON.