(No Model.)

2 Sheets—Sheet 1.

E. G. ACHESON.

ELECTRICAL FURNACE.

No. 560,291. Patented May 19, 1896.

Fig. 1.

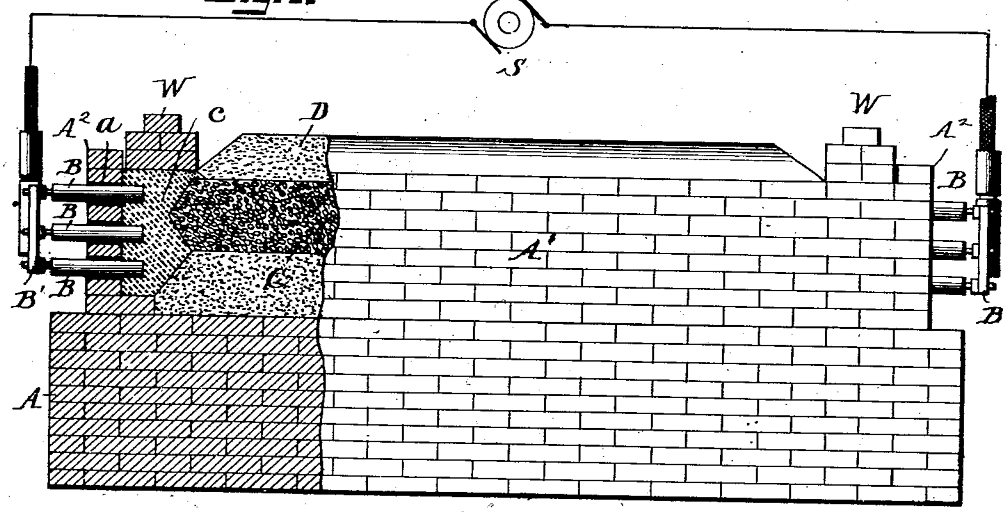


Fig. 2.

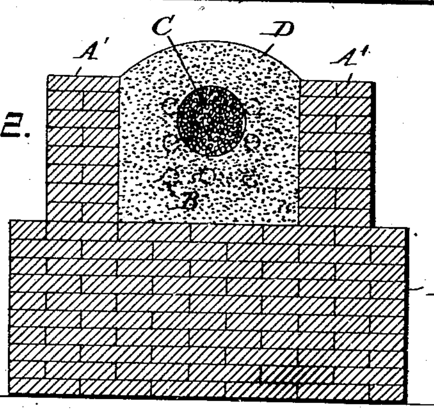


Fig. 3.

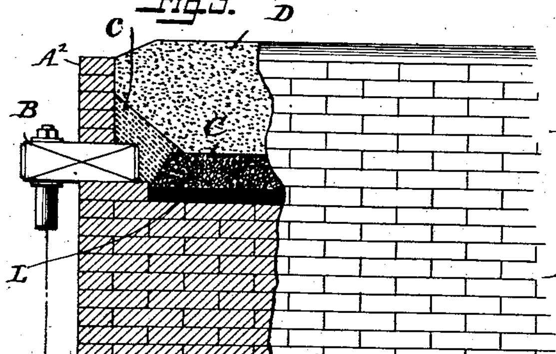
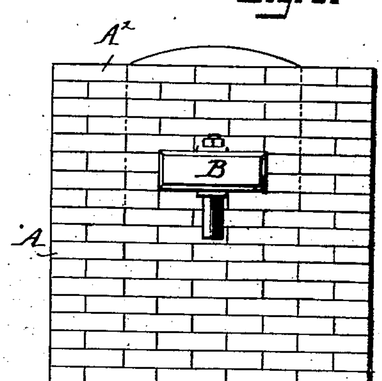


Fig. 4.



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(No Model.)

2 Sheets—Sheet 2.

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ELECTRICAL FURNACE.

No. 560,291. Patented May 19, 1896.

Fig. 5.

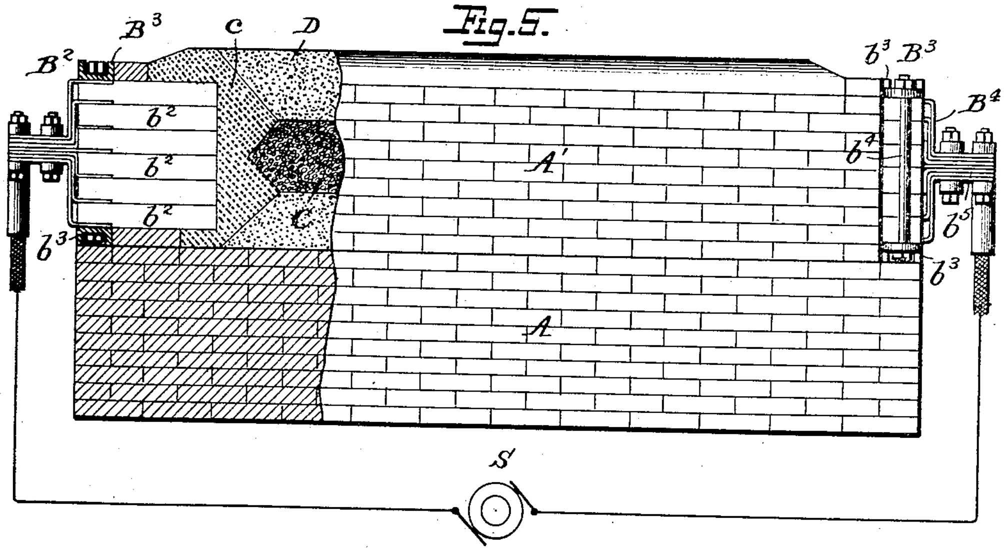


Fig. 6.

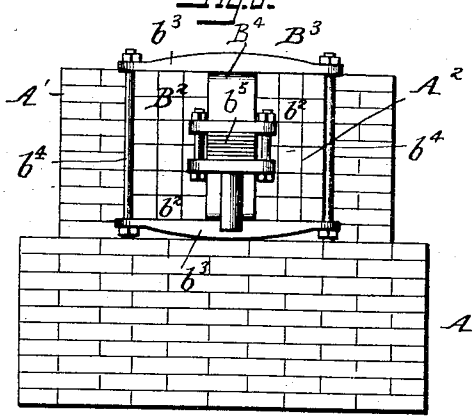
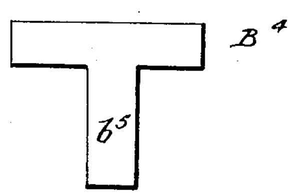


Fig. 7.



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UNITED STATES PATENT OFFICE.

EDWARD GOODRICH ACHESON, OF MONONGAHELA CITY, PENNSYLVANIA.

ELECTRICAL FURNACE.

SPECIFICATION forming part of Letters Patent No. 560,291, dated May 19, 1896.

Application filed June 25, 1894. Serial No. 515,672. (No model.)

To all whom it may concern:

Be it known that I, EDWARD GOODRICH ACHESON, a citizen of the United States, residing at Monongahela City, Washington county, State of Pennsylvania, have invented certain new and useful Improvements in Electrical Furnaces, of which the following is a specification.

My invention relates to the production of silicide of carbon, or "carborundum," as it is commonly termed, such as is described and claimed in my Patent No. 494,767; and it has for its objects to improve and cheapen the production of such material; and it consists in the various features of invention, substantially as hereinafter more particularly pointed out.

One of the objects of my invention is to improve the method of production of the material above set forth, and in carrying out this portion of my invention I make use of an electric furnace, whereby the materials used in the production of the silicide of carbon may be more economically and effectively treated by the electric current, and I utilize a furnace for carrying out this method substantially such as will be hereinafter described. In carrying out my method I provide a well-defined path or core in the furnace, through which the electric current passes and to which it is restricted to a great extent, while the material to be treated and operated upon to produce the silicide of carbon is so placed or arranged in the furnace as to receive its heat energy from the core in lines diverging from the direction of the path of the electric current, in contradistinction to those furnaces in which the materials being operated upon are intermingled with a conducting medium for the electric current and are operated upon more or less directly, the heat energy in this case being produced by immediate contact with and through the mass of material being treated, while in my case the heat energy is expended more especially and directly upon the core and is transmitted to the material being treated more or less indirectly. In my present invention the core forming the path of the electric current, while offering more or less resistance to the passage of the current, so that it will become sufficiently heated, is of relatively lower resistance to the electric current than the resistance of the material being treated, so that not only does the core form a more direct path for the passage of the electric current, but a path of less resistance, so that practically a very small portion, if any, of the current diverges from the path and passes through the material being operated upon.

Other features of my invention reside in the character of the mass to be treated, and I will now proceed to describe the preferred means and manner of carrying out my invention, reference being had to the accompanying drawings, in which—

Figure 1 is a side view, partially in section, of a furnace for carrying out my invention. Fig. 2 is a vertical transverse section of the same. Fig. 3 is a partial sectional view showing another arrangement. Fig. 4 is an end view of the same. Fig. 5 is a partial sectional view of still another arrangement. Fig. 6 is an end view of the same, and Fig. 7 is a detail.

The furnace comprises a receptacle, which may be of any desirable form, but preferably of relatively great dimensions in the direction of the path of the current compared to its cross-section, and is built up of some refractory material, which is also electrically non-conducting—as, for instance, fire-brick. I have shown in the drawings a base A, forming a solid foundation, upon which is erected the receptacle having the sides A′ and ends A². These side walls A′ are constructed in a manner to form loose joints between the brick or other material composing the walls, in order to permit the free escape of gases resulting from the operations, the gases burning at these points of escape, and thereby contributing to a greater or less extent to the heating of the materials operated upon. The end walls are arranged to furnish a bearing for the electrodes, and these may be variously constructed in accordance with the particular form of electrodes used. Thus, for instance, in Figs. 1 and 2 I have shown an electrode comprising a number of carbon rods B, passing through openings in the end of the furnace, which openings are lined, as at *a*, with some highly refractory material, as asbestos or the like. The outer ends of these rods are connected together electrically in any suitable way, as by a terminal plate B′, to which the conductor leading from the source of electric energy S is connected in any suitable way, the object being to distribute the electric energy throughout all the rods as evenly as possible and to provide a large area of contact between the core and the electrodes in the interior of the furnace. In the form shown in Figs. 3 and 4 in place of a number of carbon rods I have shown a single terminal in the form of a plate or block of carbon or similar conducting material, which is connected to the source of supply in a similar manner. A preferable construction of electrodes is shown in Figs. 5 and 6, wherein practically the whole end of the furnace is comprised in the electrode B^2. This electrode is composed in the present instance of a number of rectangular bars of carbon b^2, arranged in a suitable confining frame or clamp B^3, which in this instance comprises the metallic bars or plates b^3, connected by screw-rods b^4, whereby the various carbon rods may be held in close contact with each other. In order to supply the current to these rods with the least possible resistance and to evenly and thoroughly distribute it throughout the mass of the rods, I make use of a series of plates B^4, preferably of copper, which are placed between the successive layers of bars and are held in intimate contact with the faces of the bars by the frame B^3, and for convenience of connecting the electric terminals therewith these plates are provided with tongues or extensions b^5, which can conveniently be brought together, as clearly seen in Fig. 6, and secured to the terminal conductor, so that it shall offer little resistance to the passage of the current and shall thoroughly distribute it throughout the mass of the electrode. The electrodes at each end of the furnace have practically the same arrangement, only one being shown in detail in the drawings.

In preparing the furnace for operation I provide a path for the passage of the electric current through the furnace, and I have shown it in the form of a core C. This core is composed primarily of some refractory material which offers a greater or less resistance to the passage of the current, but which is of a lower resistance than the mass of material being operated upon, and while various substances may be used as a core and it may be in a solid mass or in a granular condition I preferably use granular carbon, the size of the individual grains varying in accordance with the size of the furnace and the conditions of the current being used. For instance, in a furnace where the core is about eight feet in length and the maximum value of the energy of the current approximately one hundred thousand watts, the diameter of the core being approximately ten inches, the individual grains composing the core are preferably about three-sixteenths of an inch in diameter. It will be understood that I do not limit myself to these precise dimensions in connection with this amount of electric energy; but practice has demonstrated that these proportions are most effective.

Carbon in its various forms may be used as a core, and the relative sizes and dimensions of the core will vary in accordance with the character of the carbon and its electrical conductivity. For instance, in forming a core of granulated coke of the standard quality, made from bituminous coal, I make the core substantially of the dimensions stated, and I have found that after once using the character of the grains has become changed in the matter of form and electrical conductivity to such an extent as to render it desirable to form the core when constructed of these altered grains of a smaller diameter than when made of the original coke.

While the core, as above described, may extend throughout the length between the electrodes, it is preferable to reduce the size of the particles forming the core at its ends to improve the contact between the core and the electrodes, making more intimate contact with the electrodes and aiding in the ready passage of the current through the core, and I have shown at *c* a portion of the particles of the core in a reduced condition. Moreover, it is exceedingly important to prevent the material to be treated coming in contact with the electrodes, in order to avoid the formation of incrustations on the electrodes, which interfere with the free passage of the electric current, and with this object in view the inner ends of the electrodes enter into the body of the core. In order to aid in maintaining intimate contact between the particles of the core and the electrodes, I sometimes apply a weight W, as indicated in Fig. 1, or the same results are accomplished to a greater or less extent by arranging the electrodes in the position indicated in Fig. 3, where the weight of the mass tends to maintain intimate contact. It is sometimes desirable to line the furnace with some refractory material—as, for instance, fire-clay—and I have indicated in Fig. 3 a lining or pieces L of such refractory material.

Arranged in the furnace and surrounding the core is the mass of materials to be treated by being subjected to the influence of the intense heat generated in the core by the passage of the electric current, and this mass is indicated at D. Of course it will be understood that this mass will vary in its composition according to the purposes and objects for which the furnace is used and the products to be obtained, and in the present instance, in which I use the furnace in the production of carborundum, this mass comprises a mixture of some carbonaceous material, a silicious material, a suitable fluxing material, and a substance which will add to the electrical resistance of the mass, while it acts to render the mass more porous and to aid in the escape of the gases throughout the mass. Thus a preferred mixture for the production of carborundum comprises twenty parts, by weight, of coal, coke, or other form of carbon reduced to small particles, twenty-nine parts of sand, five parts of common salt, and a sufficient quantity of fibrous material—such, for instance, as sawdust or the like—in about two parts, by weight. These materials are intimately mixed together and are packed in the furnace so as to surround the core practically throughout its length. Generally the mass is placed directly in contact with the surface of the core; but in some instances I have interposed means to separate the core from the mass—such, for instance, as layers of paper or similar material; but these of course are destroyed in the ordinary operation of the furnace.

I find it exceedingly advantageous to use as a carbonaceous material a hydrocarbon—such, for instance, as anthracite coal, as this is not only exceedingly cheap, but it is rich in carbon, and the parts which would ordinarily be a waste in carrying out my process in this case are utilized as a fuel to aid in heating the mass, thereby reducing the electric energy necessary to produce any given amount of product.

From the above it will be seen that the charge of the furnace comprises as its essentials a conducting-core between the electrodes, which core is as nearly elementary in its composition as possible—that is, it should be (when carbon is used) as pure carbon as can be readily obtained—and it should be in a form to offer less resistance to the passage of the electric current than the surrounding material to be operated on, and at the same time it should be capable of being heated to an intense degree without destruction. It is also well understood that in producing a crystalline product it is necessary to have some base on which the crystals can commence to form, and in the electrometallurgical formation of crystals, which in this case is contemplated, the laws governing the formation of crystals are not departed from, and the core forms the necessary groundwork for the growth of the crystals, which are formed in a ring or cylinder around the mass of the core, the nature of the constituents of the original mixture being destroyed as the crystalline cylinder increases in its dimensions. Thus in the carrying out of my invention it will be seen that the electric current passes through the core connecting the electrodes, and it is necessary to the successful operation that practically all of the current should be conducted through the mass of the core, as the passage of the current or any part thereof through the mixture of the materials is detrimental to the production of the crystalline products, and when any material amount of current does pass through the mixture the successful production of crystals is prevented. It will be seen that the core becomes heated to a high degree of temperature by the passage of the current, and the heat therefrom is imparted to the surrounding mass of material in lines diverging from the lines of the current through the core, and, as before intimated, the combustion of the gases, and to some extent the carbon in the mixture in that portion of the charge exposed to the air, aids in heating the mass, thereby hastening the process and producing a saving in the amount of electric energy expended for a given output.

What I claim is—

1. The method substantially as hereinbefore set forth of producing silicide of carbon, which consists of interposing between the terminals or electrodes of an electric circuit a core of granulated refractory material of comparatively low resistance forming a conducting-path for the electric current, and surrounding this core with the mass comprising silicious and carbonaceous material to be treated of relatively higher resistance, whereby the heat energy of the electric current is received directly by the core, and the mass of material being treated receives the heat energy from the core in lines diverging from the direction of the path of the electric current.

2. A mass to be treated in an electric furnace for the production of silicide of carbon, comprising a carbonaceous material, a silicious material and a fibrous material, substantially as described.

3. A mass to be treated in an electric furnace for the production of silicide of carbon, comprising a carbonaceous material, a silicious material, a fibrous material and a flux, substantially as described.

4. A mass to be treated in an electric furnace for the production of silicide of carbon, comprising a mixture of anthracite coal and sand, substantially as described.

In testimony whereof I have signed my name to this specification in the presence of two subscribing witnesses.

EDWARD GOODRICH ACHESON.

Witnesses:

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F. L. FREEMAN.