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METHOD OF MANUFACTURING GRAPHITE ARTICLES.

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1,357,290. **Patented Nov. 2, 1920.**

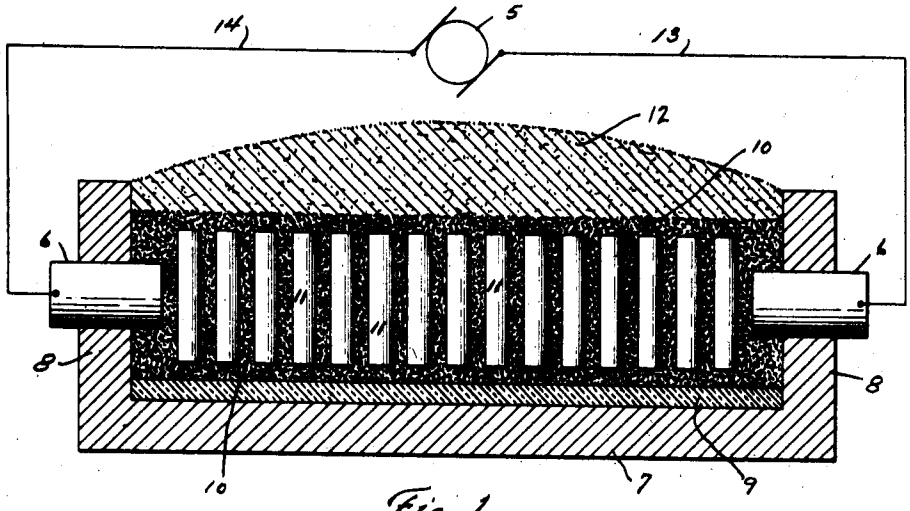


Fig. 1.

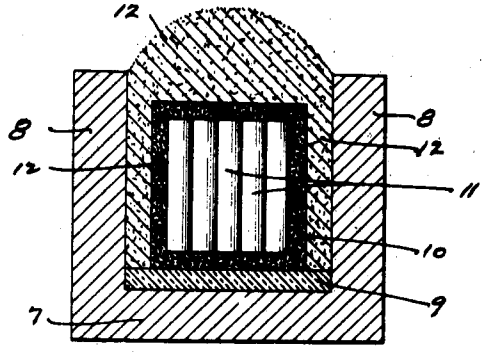


Fig. 2.

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METHOD OF MANUFACTURING GRAPHITE ARTICLES.

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To all whom it may concern:

Be it known that I, FRANK RAYMOND KEMMER, a citizen of the United States of America, and a resident of the city of Niagara Falls, county of Niagara, and State of New York, have invented certain new and useful Improvements in Methods of Manufacturing Graphite Articles, of which the following is a full, clear, and exact description.

My invention relates to new and useful improvements in the art of manufacturing articles of graphite and more particularly consists in a novel method of producing such articles in an electric furnace.

It has been found that such carbon articles as electrodes, anodes, motor and generator brushes, battery carbons, and the like are much improved for the purposes to which they are intended when they are so treated that more or less of the amorphous carbon is converted into graphitic carbon.

My invention subjects such carbon articles to a high temperature so that more or less of the contained carbon is graphitized in a uniform manner and in such a way as to prevent or reduce the breaking and injury of the articles so treated and at the same time the method is so carried out that this result is effected in the most economical manner. In carrying out my invention such articles are subjected to a very high temperature in an electric furnace, in which the temperature is produced by a powerful electric current while the articles are embedded in or surrounded by carbonaceous materials.

The method heretofore employed in making articles of graphite are well known. They consist in placing the formed articles made of amorphous carbon in an electric furnace of the resistance type and then passing the current through these so that they are heated to such a high temperature that the amorphous carbon is converted more or less completely into graphite. Thus if, for example, it is desired to graphitize carbon rods, these rods are placed in a furnace with their longest dimensions horizontal and transverse to the path of the current. When the current is passed through a mass of carbon rods of this kind the resistance of the points of contact of the rods is so great that much heat energy is generated there and the whole mass is raised to such a high temperature that the carbons are graphitized. When the cross-section of the articles to be graphitized exceeds a certain amount the number of points of contact is so diminished that the resistance of the whole mass becomes very low and consequently it is not practicable to graphitize by passing the current through them. In such cases the articles to be graphitized are arranged in piles, always with their longest dimensions horizontal and transverse to the path of the current, and these piles are separated from each other by a space which is filled with powdered or granular coke. These spaces filled with the powdered or granular coke have a much greater resistance than the piles of carbon articles so that the resistance of the whole mass is sufficiently great to permit of graphitization by passing a current through the mass. It has been found that while these methods give fairly satisfactory results as regards the graphitization of the carbon articles, serious difficulties arise when these get beyond a certain size, for, while the graphitization is substantially complete, the articles are cracked or completely broken. This phenomenon is probably due to the great contraction of volume which occurs when the articles are converted into graphite. My invention overcomes this difficulty.

In applying my invention, I place the articles to be graphitized in the electric furnace with their longest dimensions substantially vertical and transverse to the path of the electric current and I find that when this is done the breakage and cracking of the articles during the process of graphitization is greatly decreased or altogether eliminated.

In the accompanying drawings there is indicated generally the character of furnace adapted for the purposes of my invention. In these drawings:

Figure 1 is a longitudinal, vertical section of the furnace.

Fig. 2 is a transverse, vertical section of the same with one form of the article shown therein.

In the drawings, 5 represents the source of electric energy. 6 are the terminals of the furnace. 7 is the base and 8 are the walls, each of which is preferably made of suitable brick. 9 is a suitable refractory lining material. 10 represents granular or powdered carbon, such as coke. 11 represents the carbon articles or electrodes to be graphitized in the furnace. 12 represents a heat

insulating refractory material which is preferably composed of a mixture of sand, coke and saw-dust. 13 and 14 are the conductors which lead from the source of electric current 5 to the terminals 6.

While the form and arrangement of the furnace may vary, that illustrated in the accompanying drawings has been found to be of practical utility.

The furnace having been constructed in the manner described with its refractory lining material, a layer of granular or powdered carbon 10 such as coke, is spread upon the floor of the furnace to a depth of two or three inches and on this floor of coke the articles to be graphitized are placed with their longest dimensions vertical and transverse to the path of the electric current. Preferably such articles to be graphitized are arranged in rows as indicated in Fig. 2. Such rows are then entirely surrounded with the powdered carbon or coke and additional rows are stacked in the furnace in the manner described until the full capacity of the furnace has been reached. The granular or powdered carbon is introduced into all of the spaces about the terminals 6 and between these several rows of articles to be graphitized and above the articles themselves to a suitable thickness of from one to three inches.

The furnace being thus constructed and charged, the current is started with a suitable voltage and a comparatively low amperage. The amperage is then more or less rapidly increased until it registers in the neighborhood of four thousand without substantial change in the voltage, after which the voltage is gradually lowered and the amperage is continuously increased until the graphitization is complete. When the contents of the furnace have been suitably cooled the outer covers are removed and the articles are taken from the furnace when they will be found to be converted most perfectly into soft graphitic carbon and substantially none of the articles so treated will be found to be cracked or broken.

While it may not be possible to arrange carbon articles of the kind referred to when they are irregular forms with their longest dimensions exactly vertical and transverse to the path of the current, still it will be usually found that such articles of irregular shape may be placed in positions in the furnace where they will substantially conform to such vertical and transverse arrangement. When so placed the graphitization will be perfect and the articles will very few of them crack or break.

Having thus described my invention what I claim is:

1. A method of graphitizing electrodes or other carbon articles which consists in placing such articles in an electric furnace with their longest dimensions vertical and then passing an electric current through the same in a direction transverse to their longest dimensions.

2. A method of graphitizing electrodes or other carbon articles which consists in placing the electrodes in an electric furnace with their longest dimensions in a vertical plane, then embedding such articles in a mass of granular or powdered carbon and then passing an electric current through such articles in a direction transverse to their longest dimensions.

3. A method of graphitizing electrodes or other carbon articles which consists in placing such articles in rows in an electric furnace with their longest dimensions in a vertical plane, then surrounding the rows of such articles with granular or powdered carbon and then passing an electric current through such articles in a direction transverse to their longest dimensions.

4. A method of graphitizing electrodes or other carbon articles which consists in placing such articles in rows in an electric furnace with their longest dimensions in a vertical plane, then surrounding the rows of such articles with coke and then passing an electric current through such articles in a direction transverse to their longest dimensions.

In testimony whereof, I have hereunto signed my name.

FRANK RAYMOND KEMMER.