W. A. SMITH.

ELECTRIC RESISTANCE FURNACE.

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1,004,924. Patented Oct. 3, 1911.

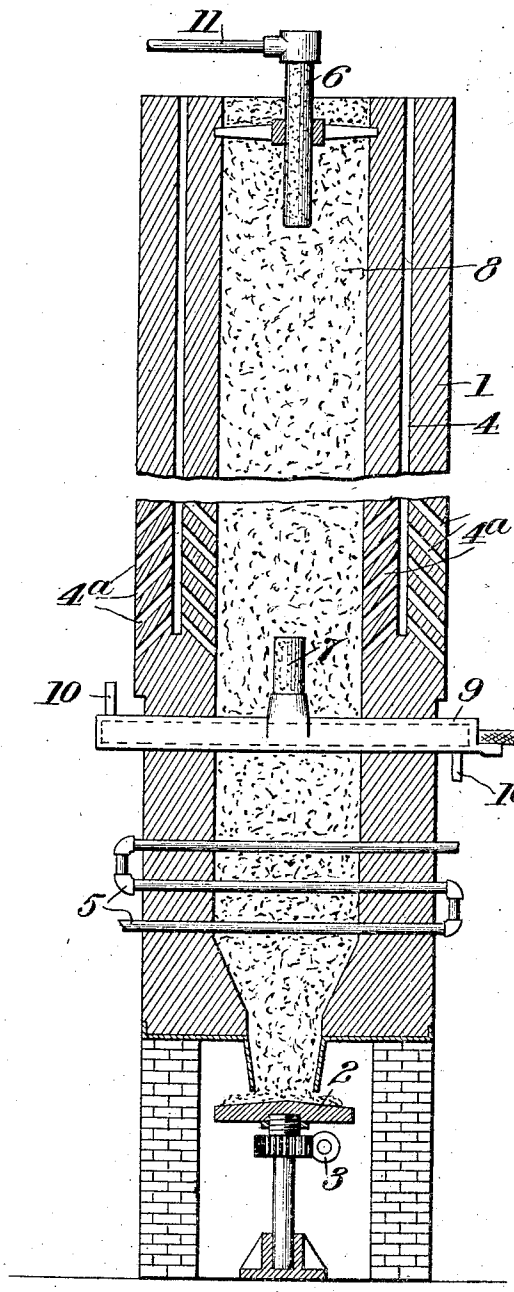

Fig. 1.

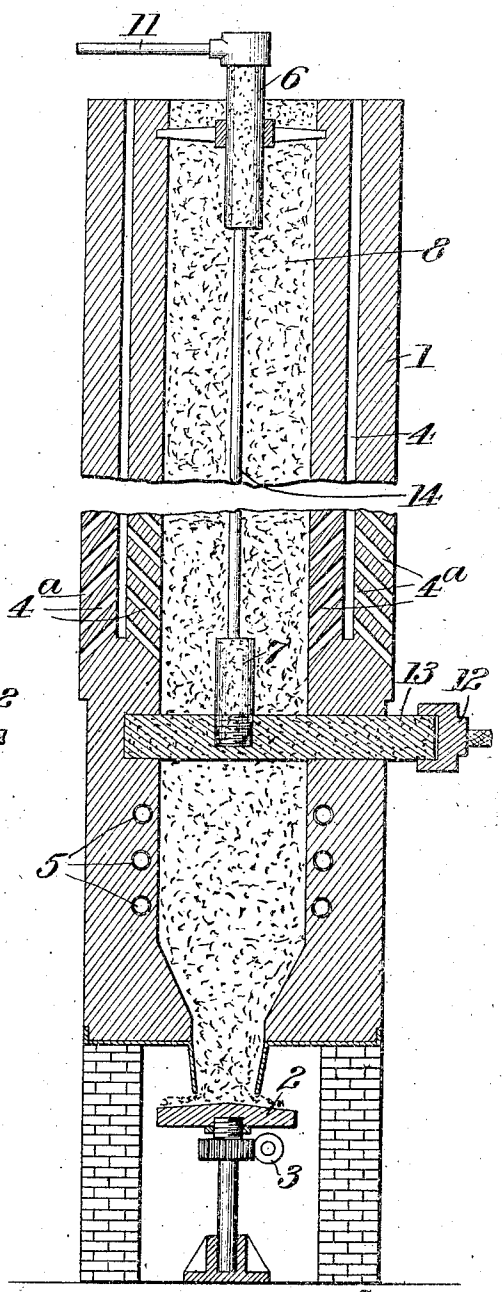

Fig. 2.

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UNITED STATES PATENT OFFICE.

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ELECTRIC-RESISTANCE FURNACE.

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To all whom it may concern:

Be it known that I, WILLIAM ACHESON SMITH, a citizen of the United States, residing at Niagara Falls, in the county of Niagara and State of New York, have invented certain new and useful Improvements in Electric-Resistance Furnaces, of which the following is a specification.

This invention relates to electric resistance furnaces, the object of the invention being the provision of a furnace of this type which shall be capable of continuous or substantially continuous operation for the treatment of such charges as do not undergo a substantial reduction of bulk as a result of the heating operation. An example of a charge of this character is carbon in its commercial forms, such as gas-coke, petroleum coke, anthracite coal, etc., which when heated undergoes a series of successive modifications dependent not only upon the temperature but upon the duration of the heat treatment, without however undergoing any marked change in bulk such as is characteristic of most metallurgical or reducing operations. For example moderate heating or heating for a brief period to a high temperature, results in the expulsion of volatile hydrocarbons; by longer heating at sufficient temperatures such impurities as silica, alumina, lime, oxids of iron, etc., are driven off, and the carbon undergoes a progressive increase in density and electrical conductivity and becomes polymerized, and may be converted ultimately into graphite.

For many industrial uses, as for example electrode compositions, battery fillers, etc., a close adjustment of time and temperature is required to convert a given raw material into a product of the desired character; and for the performance of operations of this kind the intermittently-operated furnace is always employed in practice. In all cases where it has been sought to render the operation of electrically heating carbon continuous, so far as I am aware, the electric current has been caused to traverse the body of the carbon or carbonaceous material constituting the charge, in a direction transverse to the direction of movement of the charge, that is to say, either at right angles or in other angular relation thereto, the result in all cases being that the charge fails to receive the prolonged treatment under substantially uniform temperature conditions which is essential to securing the best results, whether the object be to shrink, purify, polymerize or graphitize the charge.

A further defect of prior operations in which the heating current traversed the charge under treatment, is that it has heretofore proved impracticable to secure that distribution or limitation of the path of the current which would be most advantageous for the purposes in view. The conductivity of carbon increases with the temperature, and the current tends therefore to follow indirect and irregular paths which include the more highly heated portions of the charge. For the same reason there is a strong tendency for the current to follow restricted paths between the electrodes with the result that whereas a portion of the carbon may be heated to an uncontrollably high temperature, other portions thereof traverse the furnace without adequate or proper heating. The resulting lack of uniformity in the product renders it quite unsuitable for any technical use.

In the furnace which forms the subject-matter of the present invention the electric current for heating is passed either through the body of the charge as a resister, or wholly or in part through a resister independent of the charge, between terminals which are comparatively widely spaced; and the charge is progressively advanced either continuously or intermittently, in a direction which is substantially parallel to the lines of flow of the electric current. In this way the charge may be subjected for such period as may be desired, depending upon the rate of advance of the charge, to substantially uniform temperature conditions; and it is found that by controlling the factors of time and temperature the desired product may be obtained with certainty and uniformity. This principle may be carried into effect in various ways, it being essential in all cases that such localization of the current as would result in uneven or irregular heating should be avoided.

Certain forms of apparatus embodying the invention are shown in the accompanying drawing, wherein:

Figure 1 is a central vertical section of

one form of electric furnace; and Fig. 2 is a similar view of a slightly modified construction.

In said drawing, 1 represents the wall of a furnace of the vertical shaft type, having a bottom discharge mechanism comprising a horizontal disk or slightly coned hearth 2, mounted for slow rotation by means of a worm gear 3, and adjustable relatively to the base of the furnace so that the material is discharged over the periphery of the hearth only while the same is being rotated.

4 indicates a space in the furnace walls adjacent the heating zone, said space communicating by inclined apertures 4^a both with the heating chamber and the external air, in order that the furnace gases may readily escape from the heating zone, and that a mantle of such gases may be burned within the furnace wall to economize heat.

5 indicates cooling means, represented as a system of water pipes, between the heating zone and the discharge hopper. The cooling means may be disposed in the path of the charge as in Fig. 1 or in the furnace walls as in Fig. 2, the former construction being regarded as preferable.

In the construction illustrated in Fig. 1 the furnace charge is intended to serve as the heating resister, interposed between vertically-alined, axially-arranged upper and lower terminals or electrodes 6 and 7, which are of carbon or graphite. The working end of the upper electrode 6 is embedded in the charge 8, as is also the lower electrode 7. The lower electrode is shown as supported axially of the furnace by a hollow metal bar or casing 9 carried by the furnace walls; water may be circulated through this electrode support by means of appropriate connections 10. 11, 12 represent the electrical connections to the upper and lower electrodes respectively.

Instead of the hollow electrode support 9 shown in Fig. 1, I may use a graphite bar 13, Fig. 2, into which the lower graphite electrode 7 is screwed or to which it is otherwise secured.

In Fig. 2 I have illustrated a resister 14 in the form of a carbon or graphite rod extending between the terminals 6 and 7, this construction being particularly useful when the charge, in its unheated state, is a comparatively poor conductor of electricity.

In either construction the lower electrode is so supported that the downward movement of the charge is not substantially impeded, such movement being controlled by the discharge device, which is of such character as to afford a regulated downward movement of the charge, whereby all portions of the charge may receive a practically even heat-treatment. Obviously, the single carbon pencil constituting the upper electrode may be replaced by a group of such pencils, but in such case it is advisable to provide suitable means for securing a substantially even distribution of the heating effects from the several electrodes. This may be accomplished by known methods, as for example by making the several pencils the terminals of the polyphase heating circuit, by the provision of suitable automatic regulators for the individual pencils, etc.

In operation, the furnace is filled with carbon or carbonaceous material in a suitably subdivided state and the electric circuit is closed, an independent resister or starting core being used or not as the conditions may require. The portion of the charge between the electrodes is heated to a high and substantially uniform temperature, and as the heating proceeds is advanced, either continuously or by stages. The movement of the charge is in a direction substantially parallel to the lines of current flow, and the charge is subjected to substantially equable temperature conditions for a period which is dependent upon its rate of advance, the actual temperature being controlled by the quantity of current passing. By proceeding in this way, all factors being under control of the operator, it has been found possible so to regulate the operation that a substantially uniform product of the desired character is obtained.

I claim:

1. An electric resistance furnace comprising a shaft, a terminal or terminals arranged near the upper end thereof, a second terminal or electrode axially located intermediate the ends of the shaft and supported in such manner as to permit free passage of the charge and means for causing a regulated downward movement of the charge.

2. An electric resistance furnace comprising a shaft, a terminal or electrode arranged near the upper end thereof, a second terminal or electrode axially located intermediate the ends of the shaft and supported in such manner as to permit free passage of the charge, means for causing a regulated downward movement of the charge and cooling means for the charge below said terminals.

3. An electric resistance furnace comprising a shaft, a terminal or electrode arranged near the upper end thereof, a second terminal or electrode axially located intermediate the ends of the shaft and supported in such manner as to permit free passage of the charge, means for causing a regulated downward movement of the charge, a combustion chamber surrounding the interior wall of the furnace adjacent the heating zone, and cooling means for the charge below said zone.

4. An electric resistance furnace comprising a shaft, a terminal or electrode arranged near the upper end thereof, a second terminal or electrode axially located interme-

diate the ends of the shaft and supported in such manner as to permit free passage of the charge, a discharge orifice near the bottom of the furnace, and rotary means acting in conjunction with said orifice for causing a regulated downward movement of the charge.

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

WILLIAM ACHESON SMITH.

Witnesses:
EBEN C. SPEIDEN,
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