No. 771,249. PATENTED OCT. 4, 1904.

W. S. HORRY.

APPARATUS FOR ELECTRIC HEATING.

APPLICATION FILED JUNE 28, 1904.

NO MODEL.

Fig. 1.

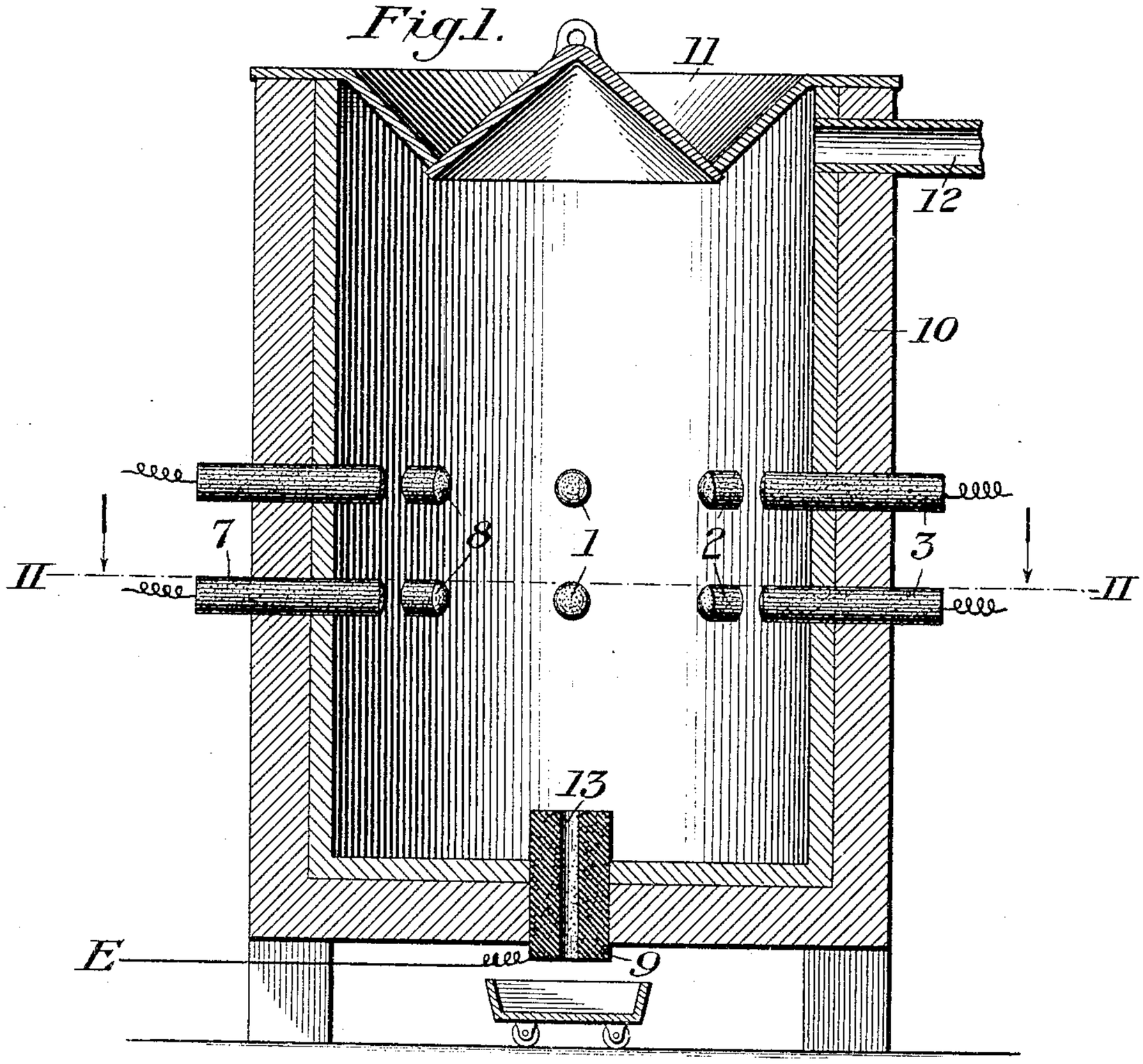
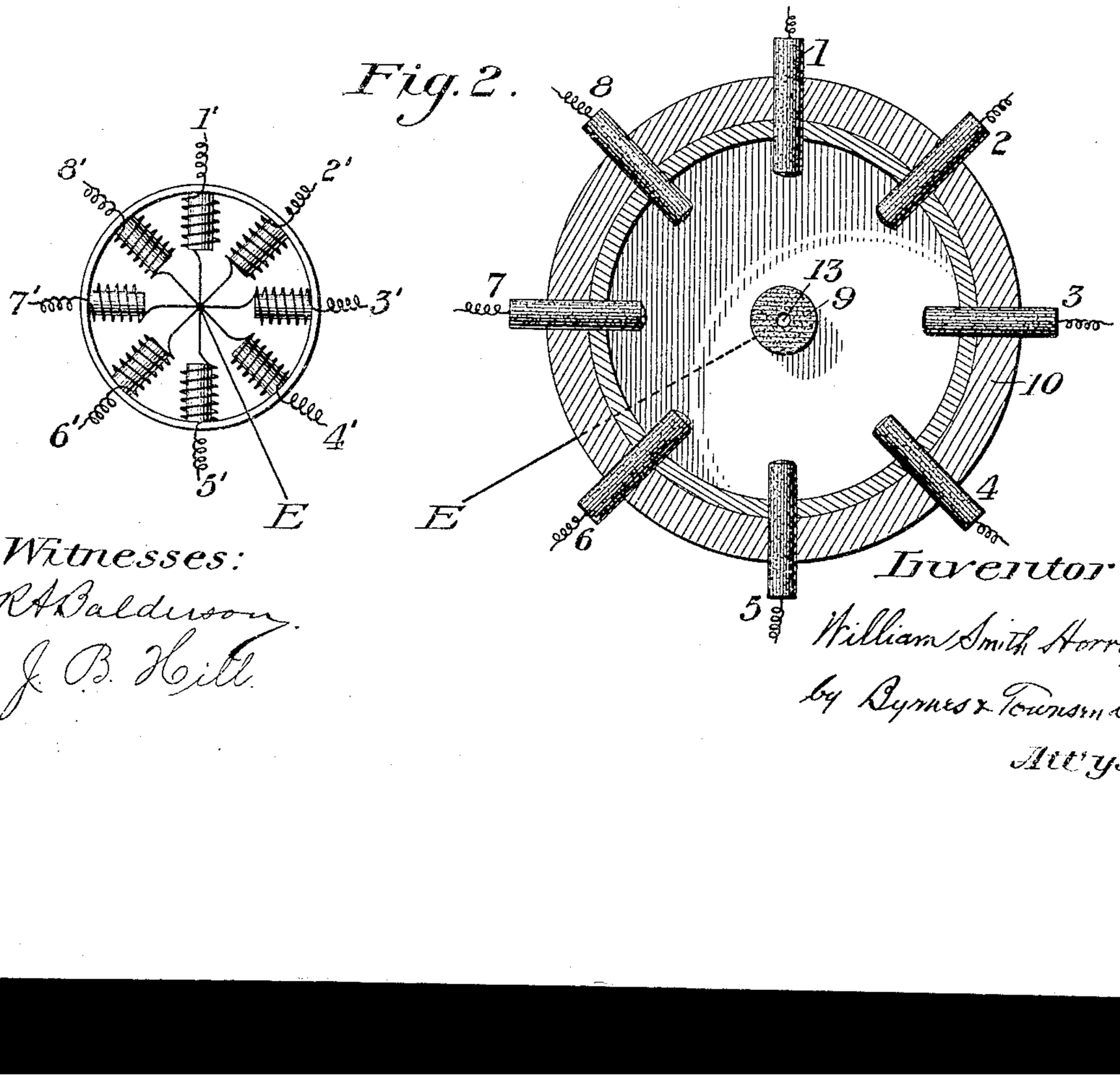



Fig. 2.

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No. 771,249. Patented October 4, 1904.

# UNITED STATES PATENT OFFICE.

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## APPARATUS FOR ELECTRIC HEATING.

SPECIFICATION forming part of Letters Patent No. 771,249, dated October 4, 1904.

Application filed June 28, 1904. Serial No. 214,483. (No model.)

*To all whom it may concern:*

Be it known that I, WILLIAM SMITH HORRY, a subject of the King of Great Britain, residing at Niagara Falls, in the county of Niagara and State of New York, have invented certain new and useful Improvements in Apparatus for Electric Heating, of which the following is a specification.

This invention relates to apparatus for electrically heating a body of conducting material, especially a mixture of a metallic compound and a reducing agent, and specifically a mixture of lime and carbon for the production of calcium carbid.

The invention contemplates the use of a polyphase alternating current, preferably one of many phases, the paths of the several phases being so distributed within the conducting-body as to effect an even heating thereof. The body to be heated is preferably circular, the active terminals of the source of polyphase current being placed substantially in contact with the body at various equidistant points around its periphery and a common or neutral terminal being placed in contact with some intermediate part of the body, preferably its center. The source of current preferably employed is a dynamo constructed to give a current of many phases with separate external fixed armature-windings, each having one end connected to a common or neutral point and the other end connected to one of the terminals in contact with the body to be heated. The path of the phase of maximum electromotive force is thus caused to shift successively from terminal to terminal through the body to be heated, following the shifting phases in the windings of the dynamo.

Referring to the accompanying drawings, Figure 1 is a vertical axial section of an electric furnace designed for the commercial utilization of the invention; and Fig. 2 is a horizontal section taken on line II II of Fig. 1, also showing the dynamo in diagram.

The circular body to be heated may be a disk of metal or a metallic crucible, but is more especially a body of calcium carbid or of carbid-forming materials, such as exists in the lower part of the furnace (shown in Figs. 1, 2) when in normal working operation.

The furnace shown, intended for the production of calcium carbid, comprises an annular stack 10, of refractory material, such as fire-brick, having at its upper end a suitable mechanism 11 for introducing raw material and preventing the escape of gases, here shown as a bell and hopper. Through the side of the stack near its upper end passes a flue 12 for withdrawing the waste gases. Near the lower portion of the stack are arranged one or more horizontal series of radial electrodes, here shown as cylindrical carbon rods passing adjustably through the sides of the stack. The number of electrodes in each horizontal series is the same as the number of separate successive windings in the fixed armature of the dynamo. Eight electrodes, numbered from 1 to 8, successively, are shown in each horizontal series; but in practice a much larger number is desirable. Extending through the furnace-hearth, preferably at its center, is an electrode 9, which may be provided with a central vertical tap-hole 13 to permit the withdrawal of calcium carbid or other molten product. The carbid may flow out continuously as it rises above the level of this electrode, or the tap-opening may be closed by a plug of refractory material and opened from time to time for the removal of molten carbid. The tap-hole may, if preferred, pass directly through the hearth.

The dynamo (shown at the left of the furnace in Fig. 2) comprises a fixed external armature having eight separate windings numbered 1′ to 8′, successively. One end of each of these windings is connected to a common or neutral point E, and the other end of each winding is connected to one of the radial electrodes. The neutral point E of the star-winding of this dynamo is connected to the central electrode 9 of the furnace either directly by a metallic conductor or through the earth. In employing this furnace to produce calcium carbid an initial charge consisting of lime and carbon is fed in through the top of the furnace. This charge may be the well-known

one containing large pieces of coke which lie in contact with each other at various points, and thereby afford direct paths for the flow of current, the line being distributed in the interstices between pieces of coke. If the normal charge, however, consists of a non-conducting mixture of coke and lime, the furnace must be first put in operation by the use of a conducting charge or by otherwise providing initial paths for the flow of current. As soon, however, as current passes through a conducting-body in the lower part of the furnace the temperature soon rises to a point where the charge above is preheated by conduction and radiation and by the waste gases arising from the zone of reduction to a temperature which will cause it to act as a resistance-conductor before it descends into the paths of current-flow. In normal working condition the body of material between the electrodes may consist of molten or partly-molten carbid or of incandescent but unreduced material or in part of both. The reduction is carried out in a continuous manner by tapping out the molten carbid and supplying fresh material as required. As the current density for each electrode cannot be carried above a certain limit, the total energy which can be employed in heating the charge depends on the number of the electrodes, which may be increased as desired either by arranging a greater number in the same horizontal series or by using any desired number of superposed horizontal series. The use of a large number of electrodes is a desirable feature, since it permits the use of relatively small electrodes without unduly heating them or their terminal connections. The use of a current of a large number of phases avoids certain difficulties incident to a single-phase current. Practically the maximum voltage of the generator is always maintained along one path through the material in the furnace, the working current thus being the maximum current of the generator instead of varying from zero to a maximum. For the same reason the total cross-section of the electrodes may be smaller than for a furnace of the same capacity using single-phase current. Any electrode may also be removed and replaced by another without noticeably interfering with the operation of the furnace. It is evident that by this invention the advantages of the direct current are retained without subjecting the furnace charge to the electrolytic effect that accompanies such current. A circular furnace is preferred, since it exposes a minimum periphery for the loss of heat by radiation. The furnace may, however, be polygonal or square.

The source of the current may be a transformer having a number of separate windings, one end of each winding being connected to a neutral or common point and the other being connected to one of the electrodes. The distinguishing feature of the invention is the use of a source of current having a star-winding and the provision of a neutral or common electrode in contact with the body to be heated.

A body of carbid-forming materials or other charge may be heated to a temperature sufficient to effect the desired reaction by employing a layer of molten iron or carbid of iron placed in the lower part of the furnace and causing the various phases of the current to pass from terminals placed around and in contact with the iron to the central electrode, the iron thereby acting as a resistance-conductor.

I claim—

1. An apparatus for electrically heating a body of conducting material, comprising means for causing different phases of a polyphase current to flow along paths which converge to a common point within said body, as set forth.

2. An apparatus for electrically heating a body of conducting material, comprising means for causing different phases of a polyphase current to simultaneously flow along paths which converge to a common point within said body, as set forth.

3. An apparatus for electrically heating a body of conducting material, comprising means for causing different phases of a polyphase current to flow along paths which converge to a common point within said body and for progressively shifting the path of the phase of maximum electromotive force, as set forth.

4. An apparatus for electrically heating a body of conducting material, comprising means for causing different phases of a polyphase current to simultaneously flow along paths which converge to a common point within said body and for progressively shifting the path of the phase of maximum electromotive force, as set forth.

5. An apparatus for electrically heating a body of conducting material, comprising a source of polyphase current and active terminals placed substantially in contact with the body at various points, whereby different phases of current are caused to flow along paths which converge to a common point within said body, as set forth.

6. An apparatus for electrically heating a circular body of conducting material, comprising a source of polyphase current and active terminals placed substantially in contact with the body at various points around its periphery, whereby different phases of current are caused to simultaneously flow along paths which converge to a common point within said body, as set forth.

7. An apparatus for electrically heating and reducing a circular body consisting of a mixture of a compound and a reducing agent, comprising a source of polyphase current and active terminals placed substantially in contact with the body at various points around its pe-

riphery, whereby different phases of current are caused to simultaneously flow along paths which converge to a common point within said body, thereby heating the body to a temperature sufficient to effect reduction, as set forth.

8. An apparatus for producing carbids by electrically heating a body of carbid-forming materials, comprising means for causing different phases of polyphase current to flow along paths which converge to a common point within said body, thereby heating the body to a temperature sufficient to effect the production of carbid, as set forth.

9. An apparatus for producing carbids by electrically heating a body of carbid-forming materials, comprising means for causing different phases of polyphase current to simultaneously flow along paths which converge to a common point within said body, thereby heating the body to a temperature sufficient to effect the production of carbid, as set forth.

10. An apparatus for producing carbids by electrically heating a circular body of carbid-forming materials, comprising a source of polyphase current and active terminals placed substantially in contact with the body or the carbid produced therefrom at various points around its periphery, whereby different phases of current are caused to flow along paths which converge to a common point within said body, thereby heating the body to a temperature sufficient to effect the production of carbid, as set forth.

11. An apparatus for producing carbids by electrically heating a circular body of carbid-forming materials, comprising means for causing different phases of a polyphase current to flow along paths which converge to a common point within said body, thereby heating the body to a temperature sufficient to effect the production of carbid, and means for tapping off the molten carbid and feeding in fresh materials as required, as set forth.

12. An apparatus for producing carbids by electrically heating a circular body of carbid-forming materials, comprising means for causing different phases of a polyphase current to simultaneously flow along paths which converge to a common point within said body, thereby heating the body to a temperature sufficient to effect the production of carbid, and means for tapping off the molten carbid and feeding in fresh materials as required, as set forth.

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

WILLIAM SMITH HORRY.

Witnesses:

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