No. 826,743. PATENTED JULY 24, 1906.

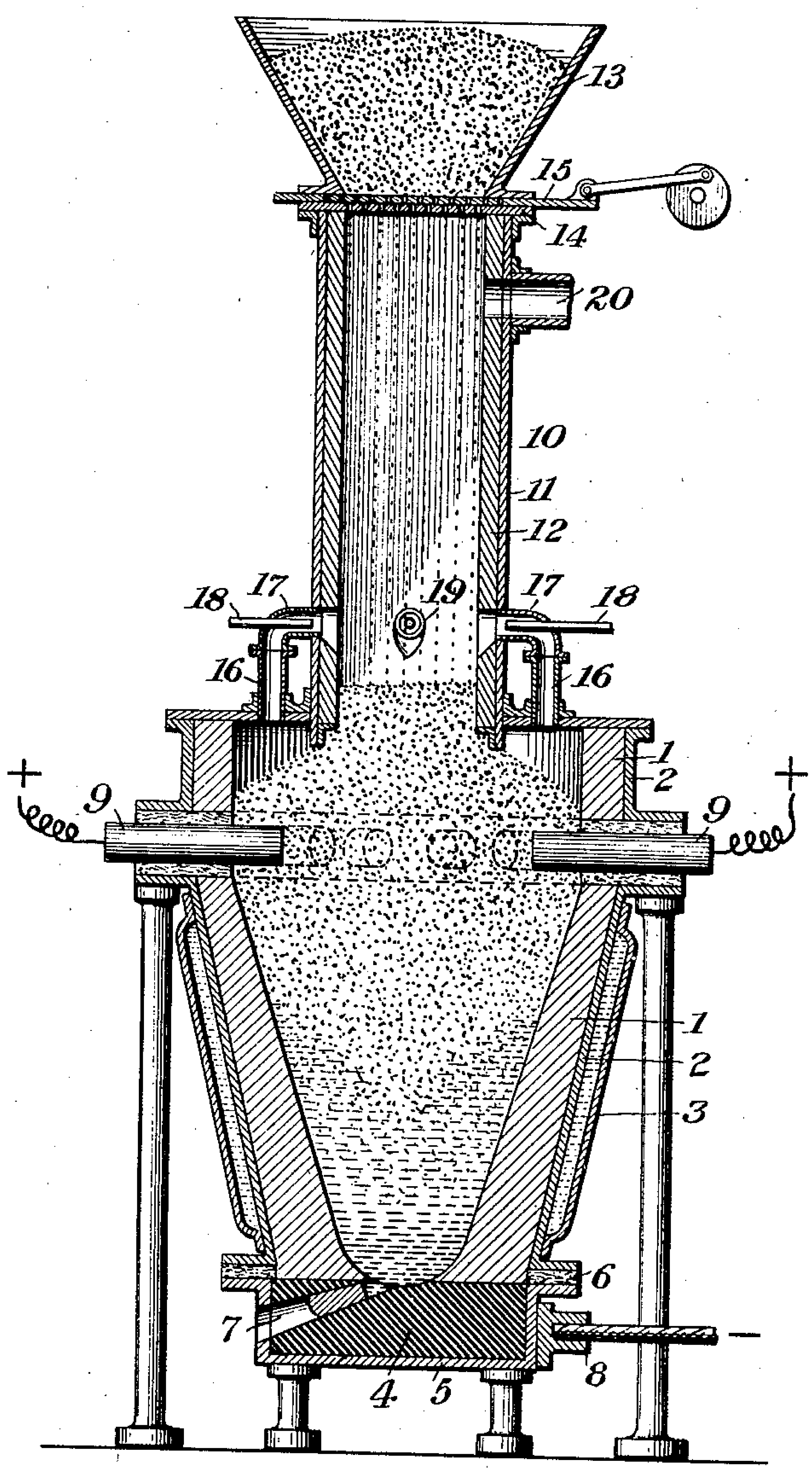
E. F. PRICE.

PROCESS OF REDUCING COMPOUNDS AND PRODUCING CARBIDS.

APPLICATION FILED OCT. 16, 1903. RENEWED JAN. 18, 1906.

2 SHEETS—SHEET 1.

Fig. 1.



Witnesses:
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J. B. Hill.

Inventor:
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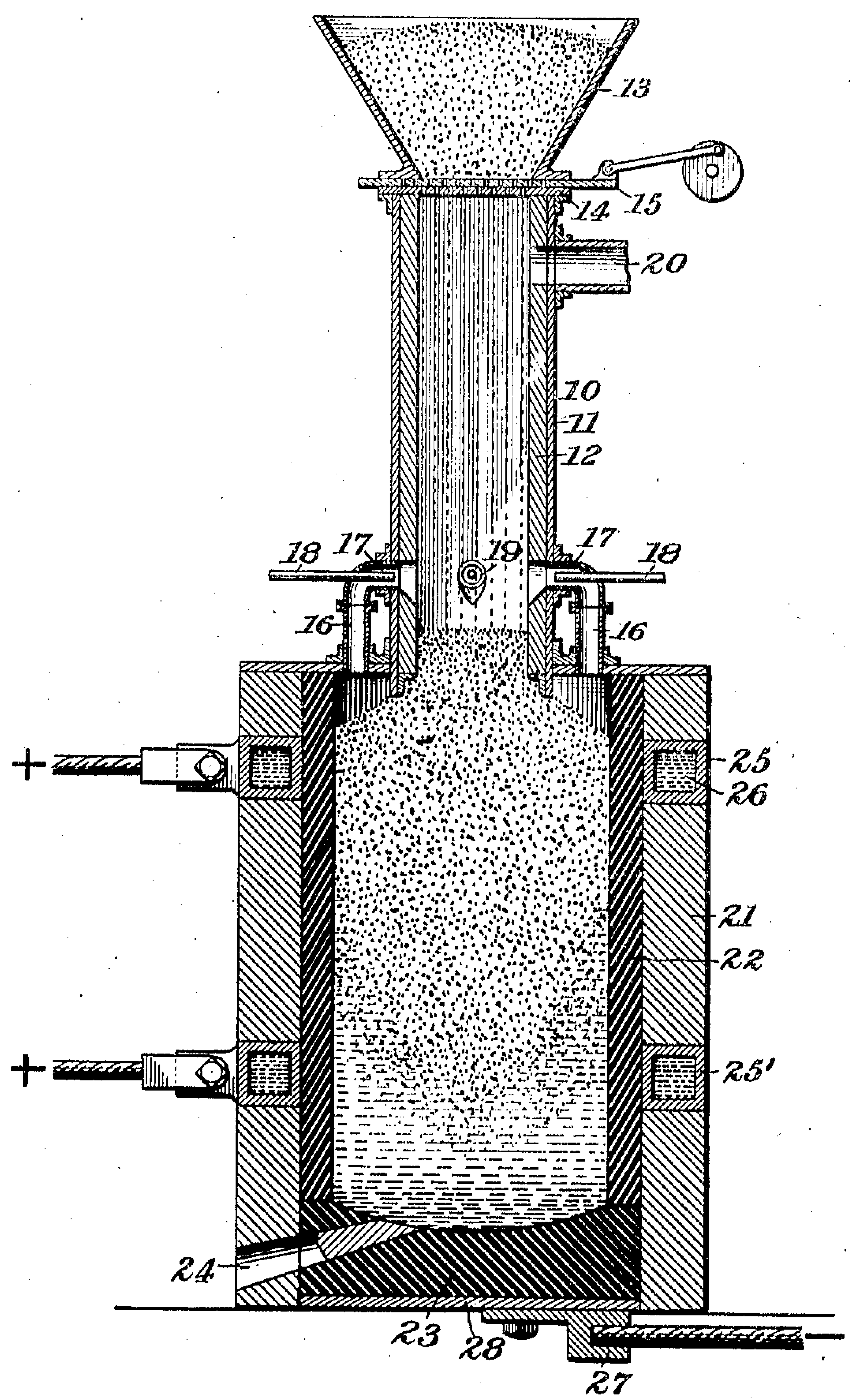
2 SHEETS—SHEET 2.

Fig. 2.



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UNITED STATES PATENT OFFICE.

EDGAR F. PRICE, OF NIAGARA FALLS, NEW YORK, ASSIGNOR TO UNION CARBIDE COMPANY, OF NIAGARA FALLS, NEW YORK, A CORPORATION OF VIRGINIA.

PROCESS OF REDUCING COMPOUNDS AND PRODUCING CARBIDS.

No. 826,743. Specification of Letters Patent. Patented July 24, 1906.

Application filed October 16, 1903. Renewed January 18, 1906. Serial No. 296,678.

To all whom it may concern:

Be it known that I, EDGAR F. PRICE, 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 Processes of Reducing Compounds and Producing Carbids, of which the following is a specification.

This invention especially relates to the production of calcium carbid by the use of an electric resistance-furnace.

According to the process the charge, usually a mixture of finely-divided lime and coke, is showered downwardly through a hot atmosphere and is then collected into a body and heated to the required temperature either by passing an electric current through the heated charge or the molten products thereof, acting as a resistance-conductor, or through a separate resistance-conductor in proximity to the charge. The preheating is preferably effected by withdrawing the waste carbon monoxid from the electric furnace and burning it in the preheating-chamber. Other fuel, such as natural gas or oil, may be employed as a substitute for or adjunct to the carbon monoxid.

The process may be carried out by apparatus of various forms. For the purpose of illustration I have shown two electric furnaces of types heretofore devised by me, in which the density of the electric current increases through the resistance-conductor from the receiving toward the discharge end of the furnace—a construction which enables the heat to be increased along the path of the electric current to a point where the carbid becomes molten and may be tapped from the furnace.

Referring to the accompanying drawings, Figure 1 is a vertical axial section of a furnace in which the working chamber decreases in cross-section from the receiving to the discharge end, and Fig. 2 is a vertical axial section of a furnace in which superposed electric currents pass through a resistance-conductor distinct from and surrounding the charge.

The furnace shown in Fig. 1 is an annular stack having a body 1 of refractory nonconducting material, such as magnesia firebrick, inclosed by a casing 2 of iron. The major portion of the body is a downwardly-converging bosh, which is surrounded by a water-jacket 3. The hearth 4 of the furnace consists of a solid mass of carbon set in an iron casing 5, which is insulated from the casing 2 by a refractory layer 6. A tap-hole 7 for the molten products extends through the hearth. One terminal 8 of the source of electric current is secured to the hearth-casing 5, the hearth thus serving as one electrode. A number of radial electrodes 9 of the same polarity, here shown as cylindrical carbon rods, pass horizontally through the side walls of the furnace near its top.

Supported upon and opening into the upper end of the furnace is the preheating-chamber 10, consisting of a shell 11 of iron, with a lining 12 of refractory material, such as magnesia or siloxicon fire-brick. Upon the upper end of the preheating-chamber is a hopper 13, the lower end of which is closed by a perforated plate 14. Another perforated plate 15 is arranged to reciprocate upon the plate 14, being driven by a crank and pitman. Pipes 16 for withdrawing the carbon monoxid from the electric furnace extend upward through its top and are connected at their upper ends to burners 17 with air-blast pipes 18, which enter openings in the sides of the preheating-chamber. One or more auxiliary burners 19, supplied by gaseous or liquid fuel from some external source, may also be employed. The products of combustion escape from the upper end of the chamber through a flue 20 and may be used in a hot-blast stove to heat the air for the burners.

In operating the furnace the mixture of finely-ground coke and lime in the hopper 13 is delivered by the perforated plates in the form of a shower, which falls freely downward through the preheating-chamber against the hot products of combustion rising from the burners and thence into the electric furnace, where it collects as a body. When the preheated charge in the furnace accumulates to a height sufficient to surround the upper electrodes 9, an electric current is passed between these electrodes and the carbon hearth through the charge, acting as a resistance-conductor. The preheated material is thereby readily raised to the temperature requisite for the production of calcium carbid, and the carbon monoxid evolved by the reaction is thereafter employed to preheat the charge. It will be seen that the density of the electric current increases along the path of the current through the charge, thereby increasing the amount of heat evolved from its upper toward its lower portion. The temperature of the charge and of the calcium-carbid product thus rises toward the lower part of the furnace and may be kept at a point sufficiently high to maintain a considerable pool of the molten carbid in the furnace, this pool then serving as a resistance-conductor as well as the charge. The molten carbid is removed through the tap-hole 7 as desired.

The furnace shown in Fig. 2 comprises a vertical stack 21 of refractory non-conducting material, such as magnesia fire-brick, within which is a continuous tubular lining 22 of refractory conducting material, such as carbon. The hearth 23 of the furnace is also of refractory conducting material, such as carbon, and has a tap-hole 24. A plurality of metal rings 25, shown as two in number, surround the carbon lining 22 and are connected to one terminal or several terminals of like sign of the source or sources of electric current. Each of these metal rings preferably has a central passage 26 for water or other cooling medium. The other terminal or terminals 27 of the source or sources of electric current are connected to an iron plate 28, which underlies and makes good electrical contact with the carbon hearth 23. The metal rings 25 are built into the brick shell of the furnace and are so arranged and spaced upon the carbon lining 22 that the current flowing through this lining acting as a resistance-conductor from the lower rings 25′ to the hearth 23 is superposed upon the current flowing from the upper ring 5 through the resistance-conductor to the hearth. The density of the total current flowing through the resistance-conductor is thus increased by one or more steps, depending on the number of rings, from the upper to the lower end of the conductor, so that it is heated ununiformly. The preheating-chamber 10, shown in connection with this second furnace, is precisely similar to that heretofore described. Similar parts have been designated by the same numerals, and further description is unnecessary.

In operating the furnace shown in Fig. 2 the charge is showered downwardly through the preheating-chamber and delivered into the electric furnace until is rises to the desired height. The resistance-conductor is then heated by electric currents passing between the rings 25 and 25′ and the carbon hearth until sufficient heat is supplied to the charge to raise it to the temperature required for the production of calcium carbid. The current flowing between the lower ring-terminal 25 and the hearth heats the lower part of the resistance-conductor to a temperature sufficient to bring the carbid into a molten condition and enable it to be removed through the tap-hole 24.

It will be seen that in the operation of each of these furnaces the charge of finely-divided lime and carbon or other material is preheated by showering it through a hot atmosphere and that the particles of the charge are then collected into a body which is further heated to the required temperature by an electric current passing through a resistance-conductor whether this conductor be the charge, the molten product thereof, or a separate conductor in proximity to the charge.

I am aware that United States Patent No. 557,057, granted March 24, 1896, to Edward N. Dickerson discloses a process of producing calcium carbid which consists in feeding the charge into an electric furnace and utilizing the carbon monoxid to heat the mixture as it is being fed into the furnace. While the present process is generically included within the terms of this patent, it specifically differs therefrom in that the charge is preheated by being showered downwardly through the burning carbon monoxid instead of being packed in a muffle which is heated externally.

I am also aware that United States Patent No. 656,599, granted August 21, 1900, to Reuben Doolittle describes a process of making carbids in which the charge falls downwardly through a vertical shaft between burners and then between a series of electrodes. In this case, however, a large number of electrodes is necessary to heat the charge to the requisite high temperature on account of the short period of time during which it is exposed to the action of each electric arc as it falls through it. In my process the preheated particles of the charge are collected into a body and are then efficiently heated by the action of an electric current, the hot charge and its molten product preferably being employed as a resistance-conductor.

While the process has been specifically described in connection with the production of calcium carbid, it is obvious that it may be employed for various chemical and metallurgical operations in which finely-divided material must be heated to a high temperature.

The term "relatively large body" occurring in claims 12, 13, 14, 15, 16, and 17 means the body produced by arresting the downward movement of the falling particles of the shower until a considerable amount of the material accumulates in the region of the smelting zone, so that it can be subjected to the electric heating for a relatively considerable period. By collecting such considerable amount of material and surrounding the smelting zone therewith the heat imparted to the showered charge is retained in the material and the body of material surrounding the smelting zone serves to retain the heat developed by the electric current.

The term "divided materials" is intended to mean ground, pulverized, comminuted, granular, and similar materials.

I claim—

1. The process of smelting a charge of divided materials, which consists in preheating the charge by showering it through a hot atmosphere, collecting the showered particles into a body, and electrically heating the body to the required temperature by an electric current passing through a resistance-conductor, as set forth.

2. The process of smelting a charge of divided materials, which consists in preheating the charge by showering it through a hot atmosphere, collecting the showered particles into a body, electrically heating the body to the required temperature by an electric current or currents passing through a resistance-conductor, and increasing the heat supplied by said resistance-conductor along the path of the electric current, as set forth.

3. The process of smelting a charge of divided materials, which consists in preheating the charge by showering it through a hot atmosphere, collecting the showered particles into a body, electrically heating the body to the required temperature by an electric current or currents passing through a resistance-conductor, and increasing the heat supplied by said resistance-conductor along the path of the electric current to a point where the product becomes molten and may be tapped out, as set forth.

4. The process of smelting a charge of divided materials, which consists in preheating the charge by showering it through a hot atmosphere, collecting the showered particles into a body, electrically heating the body to the required temperature by an electric current or currents passing through a resistance-conductor, and increasing the current density along the path of the electric current in said resistance-conductor, as set forth.

5. The process of smelting a charge of divided materials, which consists in preheating the charge by showering it through a hot atmosphere, collecting the showered particles into a body, electrically heating the body to the required temperature by an electric current or currents passing through a resistance-conductor, and increasing the current density along the path of the electric current in said resistance-conductor to a point where the product becomes molten and may be tapped out, as set forth.

6. The process of producing calcium carbid, which consists in showering a charge of divided lime and carbon through a hot atmosphere, collecting the showered particles into a body, and electrically heating the body to the required temperature by an electric current passing through a resistance-conductor, as set forth.

7. The process of producing calcium carbid, which consists in showering a charge of divided lime and carbon through a hot atmosphere, collecting the showered particles into a body, electrically heating the body to the required temperature by an electric current passing through a resistance-conductor, and increasing the heat supplied by said resistance-conductor along the path of the electric current, as set forth.

8. The process of producing calcium carbid, which consists in showering a charge of divided lime and carbon through a hot atmosphere, collecting the showered particles into a body, electrically heating the body to the required temperature by an electric current passing through a resistance-conductor, increasing the heat supplied by said resistance-conductor along the path of the electric current to a point where the carbid becomes molten, and tapping out the molten carbid, as set forth.

9. The process of producing calcium carbid, which consists in showering a charge of divided lime and carbon through a hot atmosphere, collecting the showered particles into a body, electrically heating the body to the required temperature by an electric current passing through a resistance-conductor, and increasing the current density along the path of the electric current in said resistance-conductor, as set forth.

10. The process of producing calcium carbid, which consists in showering a charge of divided lime and carbon through a hot atmosphere, collecting the showered particles into a body, electrically heating the body to the required temperature by an electric current passing through a resistance-conductor, and increasing the current density along the path of the electric current in said resistance-conductor to a point where the carbid becomes molten and may be tapped out, as set forth.

11. The process of producing calcium carbid, which consists in showering a charge of divided lime and carbon through a hot atmosphere, collecting the showered particles into a body, electrically heating the body to the required temperature by an electric current passing through a resistance-conductor, and burning the gases produced by the reaction to furnish the preheating atmosphere, as set forth.

12. The process of smelting a charge of divided materials, which consists in preheating the charge by showering it through a hot atmosphere, collecting the showered particles into a relatively large body, electrically heating said body to the required temperature and bringing the product into a molten con-

dition, and removing the molten product and supplying fresh materials as required, as set forth.

13. The process of smelting a charge of divided materials, which consists in preheating the charge by showering it through a hot atmosphere, collecting the showered particles into a relatively large body, electrically heating said body to the required temperature and increasing the current density along the path of the current, thereby bringing the product into a molten condition, and removing the molten product and supplying fresh materials as required, as set forth.

14. The process of smelting a charge of divided materials, which consists in preheating the charge by showering it through a hot atmosphere, collecting the showered particles into a relatively large body, electrically heating said body to the required temperature and bringing the product into a molten condition, removing the molten product and supplying fresh materials as required, and burning the gases produced by the reaction to furnish the preheating atmosphere, as set forth.

15. The process of producing calcium carbid, which consists in showering a charge of divided lime and carbon through a hot atmosphere, collecting the showered particles into a relatively large body, electrically heating said body to the required temperature and bringing the carbid into a molten condition, and removing the molten carbid and supplying fresh materials as required, as set forth.

16. The process of producing calcium carbid, which consists in showering a charge of divided lime and carbon through a hot atmosphere, collecting the showered particles into a relatively large body, electrically heating said body to the required temperature and increasing the current density along the path of the current, thereby bringing the carbid into a molten condition, and removing the molten carbid and supplying fresh materials as required, as set forth.

17. The process of producing calcium carbid, which consists in showering a charge of divided lime and carbon through a hot atmosphere, collecting the showered particles into a relatively large body, electrically heating said body to the required temperature and bringing the carbid into a molten condition, removing the molten carbid and supplying fresh materials as required, and burning the gases produced by the reaction to furnish the preheating atmosphere, as set forth.

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

EDGAR F. PRICE.

Witnesses:

CHARLES E. BILLINGS,
EDW. J. SCHNEIDER.