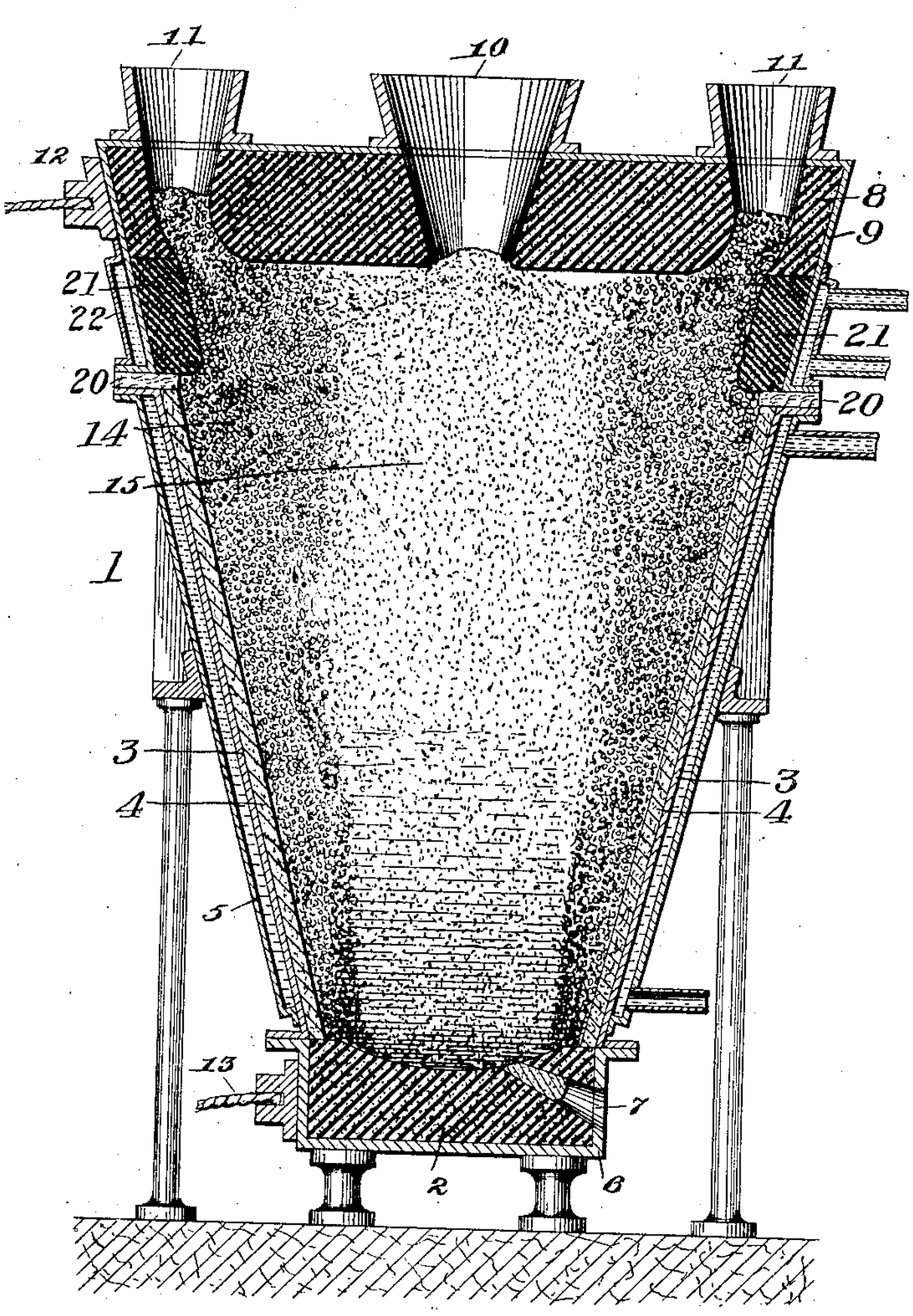
No. 750,095. PATENTED JAN. 19, 1904.

A. H. COWLES.

PROCESS OF ELECTRICALLY HEATING MATERIALS.

APPLICATION FILED NOV. 5, 1902.

NO MODEL.



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No. 750,095. Patented January 19, 1904.

UNITED STATES PATENT OFFICE.

ALFRED H. COWLES, OF CLEVELAND, OHIO.

PROCESS OF ELECTRICALLY HEATING MATERIALS.

SPECIFICATION forming part of Letters Patent No. 750,095, dated January 19, 1904.

Application filed November 5, 1902. Serial No. 130,191. (No model.)

To all whom it may concern:

Be it known that I, ALFRED H. COWLES, a citizen of the United States, residing at Cleveland, in the county of Cuyahoga and State of Ohio, have invented certain new and useful Improvements in Processes of Electrically Heating Materials, of which the following is a specification.

This invention relates to a process of electrically heating materials, especially mixtures of a metallic compound and a reducing agent, and specifically to a process of reducing such mixtures as lime and carbon for the production of calcium carbid. The process contemplates the use as a heating means of a resistance-conductor placed in proximity to the materials to be heated. This conductor is heated by an electric current passed through it, and the density of the current is suitably increased along its path, thereby heating the conductor non-uniformly.

The process may be carried out by different forms of apparatus, one of which is shown in the accompanying drawing, in which the figure is a vertical axial section of a stack-furnace.

The furnace chosen for illustration comprises a vertical frusto-conical stack 1 and a crucible or hearth 2. The stack consists of an iron shell 3, having a lining 4 of refractory non-conducting material and a water-jacket 5 surrounding it. The hearth is of refractory conducting material, such as carbon, inclosed in an iron casing 6 and provided with a tap-hole 7. The top of the furnace is closed by a cover comprising a massive plate of carbon 8 and a carbon ring 21, inclosed by an iron casing 9. The cover rests on a ring 20, of refractory insulating material, such as asbestos, which in turn rests upon the upper end of the stack. The cover is provided with a central hopper 10 and a plurality of hoppers 11 near its edge, the several hoppers communicating with the interior of the furnace through corresponding openings in the cover. A water-jacket 22 surrounds the lower portion of the cover. Secured to the iron casing of the cover is one terminal, 12, of a source of electric current, the other terminal, 13, being secured to the iron casing of the hearth.

In operation loose, broken, or granular refractory conducting material 14, such as lumps of coke or carbon, is fed into the furnace through the hoppers 11, and the charge of material to be heated 15 is fed in through the central hopper 10. The material 14 arranges itself in a vertical layer surrounding the central column 15 of the material to be heated and constitutes a resistance-conductor. It will be seen that this tubular conductor, by reason of the conical shape of the stack, decreases in cross-sectional area toward the hearth, and its resistance thereby increases downwardly. When either a direct or alternating current is caused to pass between the upper electrode or electrodes and the carbon hearth 2 and through the resistance-conductor 14, this conductor is non-uniformly heated by reason of the gradually-increasing current density toward the hearth. The heat generated by the passage of the current and conducted to the central column of material 15 thus increases downwardly. By the use of sufficient current the lower part of the resistance-conductor and of the charge within it may be brought to any desired temperature. When the charge 15 consists of a mixture of lime and carbon in proper proportions to form calcium carbid, the temperature in the charge will be gradually raised as it descends within the furnace until the materials reach a zone where they react to form calcium carbid. This carbid may be allowed to accumulate as a pool in the hearth and drawn off from time to time through the tap-hole or may be allowed to run out continuously as produced. The column 15 thereupon gradually descends, and fresh material is fed in through the hopper 10. Such portions of the resistance-conductor as are carried down with the charge may also be replenished through the hoppers 11. The central column of material is heated not only by radiation and conduction from the surrounding resistance-conductor, but also by the waste gases passing up from the zones of reduction and fusion below.

The furnace shown and described is claimed in my copending application, Serial No. 132,134, filed November 20, 1902.

I claim—

1. The process of heating materials, which

consists in placing the material in proximity to a resistance-conductor, passing an electric current through said conductor, and increasing the current density along the path of the current, through a portion of the conductor in proximity to said material, as set forth.

2. The process of heating materials, which consists in placing the material in proximity to a resistance-conductor of loose, broken or granular material, passing an electric current, through said conductor, and increasing the current density along the path of the current, through a portion of the conductor in proximity to said material, as set forth.

3. The process of reducing a compound, which consists in placing a mixture of the compound and a reducing agent in proximity to a resistance-conductor, passing an electric current through said conductor, and increasing the current density along the path of the current, through a portion of the conductor in proximity to said material, to a point where the heat generated by the resistance of the conductor effects reduction, as set forth.

4. The process of reducing a compound, which consists in placing a mixture of the compound and a reducing agent in proximity to a resistance-conductor of loose, broken or granular material, passing an electric current through said conductor, and increasing the current density along the path of the current, through a portion of the conductor in proximity to said material, to a point where the heat generated by the resistance of the conductor effects reduction, as set forth.

5. The process of producing carbids, which consists in placing carbid-forming materials in proximity to a resistance-conductor, passing an electric current through said conductor, and increasing the current density along the path of the current, through a portion of the conductor in proximity to said material, to a point where the heat generated by the resistance of the conductor causes the materials to react to form carbid, as set forth.

6. The process of producing carbids, which consists in placing carbid-forming materials in proximity to a resistance-conductor of loose, broken or granular material, passing an electric current through said conductor, and increasing the current density along the path of the current, through a portion of the conductor in proximity to said material, to a point where the heat generated by the resistance of the conductor causes the materials to react to form carbid and the carbid to be brought into a molten condition, as set forth.

7. The process of producing carbids, which consists in placing carbid-forming materials in proximity to a resistance-conductor, passing an electric current through said conductor, and increasing the current density along the path of the current, through a portion of the conductor in proximity to said material, to a point where the heat generated by the resistance of the conductor causes the materials to react to form carbid and the carbid to be brought into a molten condition, as set forth.

8. The process of producing carbids, which consists in placing carbid-forming materials in proximity to a resistance-conductor of loose, broken or granular material, passing an electric current through said conductor, and increasing the current density along the path of the current, through a portion of the conductor in proximity to said material, to a point where the heat generated by the resistance of the conductor causes the materials to react to form carbid and the carbid to be brought into a molten condition, as set forth.

9. The process of producing carbids, which consists in placing carbid-forming materials in proximity to a resistance-conductor, passing an electric current through said conductor, increasing the current density along the path of the current, through a portion of the conductor in proximity to said material, to a point where the heat generated by the resistance of the conductor causes the materials to react to form carbid and the carbid to be brought into a molten condition, and tapping off said molten carbid and supplying fresh material as required, as set forth.

10. The process of producing carbids, which consists in placing carbid-forming materials in proximity to a resistance-conductor of loose, broken or granular material, passing an electric current through said conductor, increasing the current density along the path of the current, through a portion of the conductor in proximity to said material, to a point where the heat generated by the resistance of the conductor causes the materials to react to form carbid and the carbid to be brought into a molten condition, and tapping off said molten carbid and supplying fresh material as required, as set forth.

11. The process of heating materials, which consists in placing the material in proximity to a resistance-conductor, passing an electric current through said conductor, and increasing the current density in a portion of said conductor, in proximity to said material, thereby heating it ununiformly, as set forth.

12. The process of heating materials, which consists in placing the material in proximity to a resistance-conductor of loose, broken or granular material, passing an electric current through said conductor, and increasing the current density in a portion of said conductor, in proximity to said material, thereby heating it ununiformly, as set forth.

13. The process of reducing a compound, which consists in placing a mixture of the compound and a reducing agent in proximity to a resistance-conductor, passing an electric current through said conductor, and increasing the current density in a portion of said conductor in proximity to said material, to a point where the heat generated by the resistance of the conductor effects reduction, as set forth.

14. The process of reducing a compound, which consists in placing a mixture of the compound and a reducing agent in proximity to a resistance-conductor of loose, broken or granular material, passing an electric current through said conductor, and increasing the current density in a portion of said conductor in proximity to said material, to a point where the heat generated by the resistance of the conductor effects reduction, as set forth.

15. The process of producing carbids, which consists in placing carbid-forming materials in proximity to a resistance-conductor, passing an electric current through said conductor, and increasing the current density in a portion of said conductor in proximity to said material, to a point where the heat generated by the resistance of the conductor causes the materials to react to form carbid, as set forth.

16. The process of producing carbids, which consists in placing carbid-forming materials in proximity to a resistance-conductor of loose, broken or granular material, passing an electric current through said conductor, and increasing the current density in a portion of said conductor in proximity to said material, to a point where the heat generated by the resistance of the conductor causes the materials to react to form carbid, as set forth.

17. The process of producing carbids, which consists in placing carbid-forming materials in proximity to a resistance-conductor, passing an electric current through said conductor, increasing the current density in a portion of said conductor in proximity to said material, to a point where the heat generated by the resistance of the conductor causes the materials to react to form carbid and the carbid to be brought into a molten condition, and tapping off said molten carbid and supplying fresh materials as required, as set forth.

18. The process of producing carbids, which consists in placing carbid-forming materials in proximity to a resistance-conductor of loose, broken or granular material, passing an electric current through said conductor, increasing the current density in a portion of said conductor in proximity to said material, to a point where the heat generated by the resistance of the conductor causes the materials to react to form carbid and the carbid to be brought into a molten condition, and tapping off said molten carbid and supplying fresh material as required, as set forth.

19. The process of heating materials, which consists in placing the material in proximity to a resistance-conductor of varying cross-section and resistance, and passing an electric current through said conductor, the current density increasing along the path of the current through a portion of the conductor in proximity to said material, thereby heating the material non-uniformly, as set forth.

20. The process of heating materials, which consists in placing the material in proximity to a resistance-conductor of varying cross-section and resistance and of loose, broken or granular material, and passing an electric current through said conductor and thereby heating the material non-uniformly, as set forth.

21. The process of reducing a compound, which consists in placing a mixture of the compound and a reducing agent in proximity to a resistance-conductor of varying cross-section and resistance, and passing through said conductor an electric current of sufficient volume to effect reduction, as set forth.

22. The process of reducing a compound, which consists in placing a mixture of the compound and a reducing agent in proximity to a resistance-conductor of varying cross-section and resistance and of loose, broken or granular material, and passing through said conductor an electric current of sufficient volume to effect reduction, as set forth.

23. The process of producing carbids, which consists in placing carbid-forming materials in proximity to a resistance-conductor of varying cross-section and resistance, and passing through said conductor an electric current of sufficient volume to cause the materials to react to form carbid, as set forth.

24. The process of producing carbids, which consists in placing carbid-forming materials in proximity to a resistance-conductor of varying cross-section and resistance, passing through said conductor an electric current of sufficient volume to cause the materials to react to form carbid and the carbid to be brought into a molten condition, and tapping off said molten carbid and supplying fresh materials as required, as set forth.

25. The process of producing carbids, which consists in placing carbid-forming materials in proximity to a resistance-conductor of varying cross-section and resistance and of loose, broken or granular material, and passing through said conductor an electric current of sufficient volume to cause the materials to react to form carbid, as set forth.

26. The process of producing carbids, which consists in placing carbid-forming materials in proximity to a resistance-conductor of varying cross-section and resistance and of loose, broken or granular material, passing through said conductor an electric current of sufficient volume to cause the materials to react to form carbid and the carbid to be brought into a molten condition, and tapping off said molten carbid and supplying fresh materials as required, as set forth.

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

ALFRED H. COWLES.

Witnesses:
F. W. POWER,
O. J. FRITH.