No. 893,565. PATENTED JULY 14, 1908.

H. S. BLACKMORE.

ELECTRODE.

APPLICATION FILED AUG. 31, 1907.

Fig. 3.

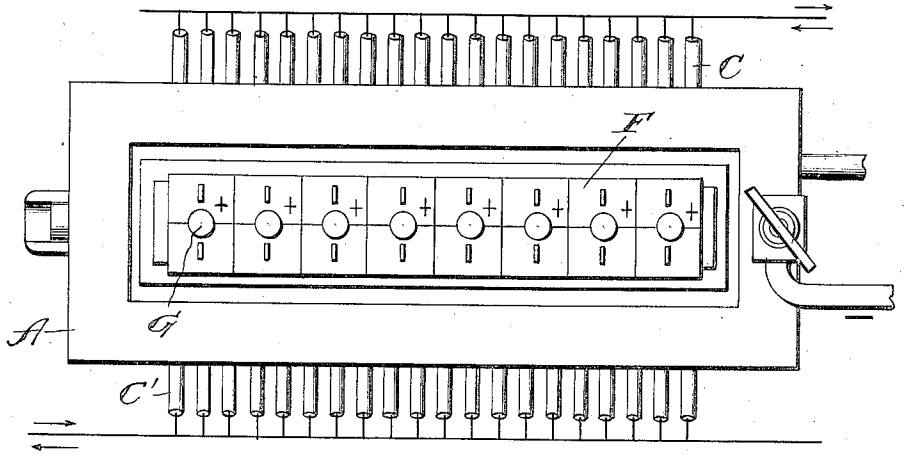
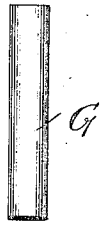


Fig. 4.

Fig. 1.



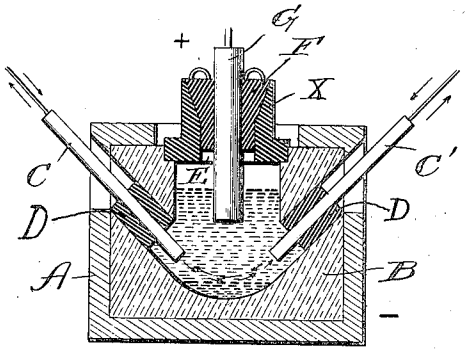


Fig. 2.

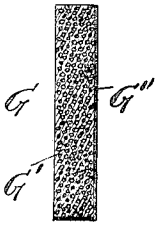
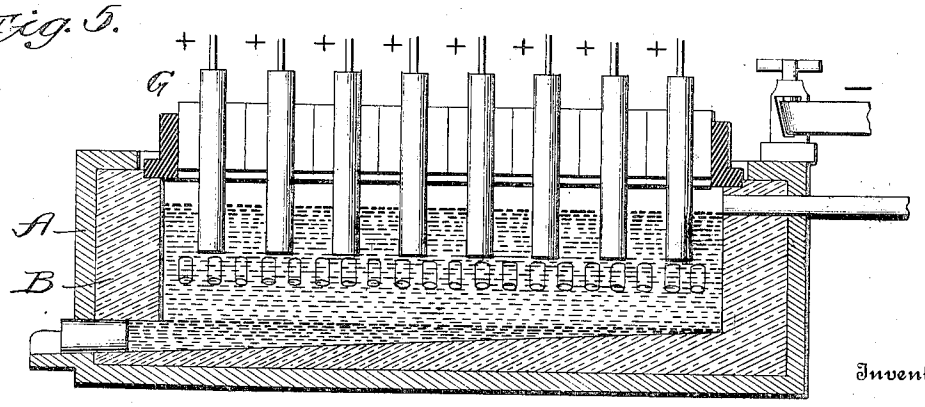


Fig. 5.



Inventor

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ELECTRODE.

No. 893,565. Specification of Letters Patent. Patented July 14, 1908.

Original application filed April 18, 1903, Serial No. 153,329. Divided and this application filed August 31, 1907. Serial No. 390,949.

To all whom it may concern:

Be it known that I, HENRY SPENCER BLACKMORE, a citizen of the United States, residing at Mount Vernon, in the county of Westchester and State of New York, have invented certain new and useful Improvements in Electrodes, of which the following is a specification.

This invention relates to electrodes for electro-chemical, metallurgical, or other purposes; and it consists of an electrode comprising metal carbid, acetylid, or other metal-carbon compound or union, together with a binder, such as carbon.

In the prior art it has been the custom, when electrodes of metal carbid have been desired, to employ the carbid, *en masse*, such as would be obtained by taking a piece of metal carbid, such as calcium carbid, and forming or manufacturing the same into any desired shape, by turning on a lathe or shaping by other mechanical means, or casting the molten carbid in a mold. It, is, however, disadvantageous to employ carbid electrodes of this character for the reason that it is expensive to manufacture the electrodes from ingots of carbid, or, in case the electrodes are cast from molten carbids, they are apt to crack, split or break, for the reason that they cannot be readily annealed, and they are also apt to become disintegrated by moist atmosphere; non-metal carbids, which are non-conductors of electricity, have also been employed as electrodes, by associating the same with a large quantity of carbon for the purpose of rendering the electrode more or less conductive, and which carbon constituted the larger constituent of the composition, approximating ninety per cent.

The present invention, which is a division of my application filed April 18, 1903, Serial No. 153,329, consists of an electrode having as a principal constituent a metal carbid, acetylid, or other metal-carbon-containing compound or union, the said substance being a conductor of electricity in contradistinction to and from non-metal carbids which are non-conductors. The presence of such non-metal carbid, acting as a resistance or resister to the passage of the current through the electrode, necessitates the association of a large amount of some foreign conductive ingredient, such as carbon, which interferes, to a great extent, with the physical properties of the carbid, and which carbid of non-metal cannot be readily utilized to obtain results of its own individual properties, without increasing the percentage content of the non-metal and non-electrically conductive carbid, to an extent that its electrical resistance would result in a large expenditure of electrical energy for its utilization. My electrode, however, contains metal carbid, acetylid, or other metal-carbon-containing compound, and therefore provides as a principal constituent, a substance which is an electrical conductor, instead of a non-conductor or resister, such as non-metal-carbid, whereby the physical and chemical properties of the metal carbid or metal-carbon-containing compound may be rendered available, without the large expenditure of electrical energy occasioned by the employment of non-metal carbids.

As an illustration of a composite electrode constituted in accordance with the present invention, I will take, for example, one comprising a metal-carbon compound, such as the so-called calcium carbid, the same being of that species of carbid known as acetylid, or, in other words, a compound of carbon with an element, such as calcium, in which the two carbon atoms are so interlinked or joined as to present the character of a dyad, or which may be considered as acetylene in which hydrogen is replaced by calcium or other element; calcium carbid (CaC_2) being considered as acetylene (H_2C_2) in which the two atoms of hydrogen are replaced by the dyad calcium, the aforesaid metal-carbon compound, being known as calcium carbid or acetylid, which compound is bonded or bound by a binder, such as carbon, in a composite or homogeneous composition, the binder existing in such limited proportion only as to unite the particles of calcium carbid in a homogeneous mass or body, said carbon binder being also a conductor of electricity.

These electrodes have the advantage, when employed in electrochemical, metallurgical, smelting, or other operations of retaining their mass-continuity while being superficially acted upon by substances or ingredients communicating therewith, when employed as electrodes, without crumbling, decomposing, or becoming interiorly disintegrated.

The formation of the composite composi-

tion of metal-carbon-containing compound, such as metal carbid or acetylid, united by carbon or other binder, is accomplished by any well known or practical means, which may be such as is usually employed to bind particles of carbon *per se* in ordinary carbon electrodes.

As an illustration of an application of my combined metal carbid, acetylid, or other metal-carbon-containing compound, with carbon or other binder as an electrode, I will take, for example, its employment in electrolytic processes, such as is usually employed for the electrical reduction of metals, or for metallurgical purposes, said application being illustrated in the accompanying drawing, in which—

Figure 1 is an elevation of my improved electrode; Fig. 2, a longitudinal section of the same; Fig. 3, a top plan view of the apparatus; Fig. 4, a vertical transverse section, and Fig. 5, a vertical longitudinal section.

Referring to the several views, the letter A indicates a suitable box or receptacle, preferably of cast iron, lined with a conductive substance B, such as carbon, into which project the heating electrodes C, C′, which pass through the insulators D, D′. The material is introduced into the apparatus through the openings E, which are closed by insulating-plugs F, passing into insulating-cover X, and through which pass the electrodes G, which consist of a mixture of metal carbid, acetylid, or other metal-carbon-containing compound G′, and a binder G″, preferably of electrically conductive nature, such as carbon, as shown in Fig. 2.

An example of the employment specifically of an electrode containing an acetylid, such as calcium carbid, may be obtained by referring to its application in connection with the reduction of metal oxy-halid or oxy-fluorid compounds or compositions, such as may be formed by heating a mixture of metal fluorid and metal oxid, or more specifically aluminium fluorid and aluminium oxid, as described and claimed as to chemical reduction in Letters-Patent of the United States granted to me May 6, 1902, and numbered 699,282, in which is described the following reaction, viz:—

$$Al_2F_6 + 2Al_2O_3 + 3CaC_2 = 6Al + 3CaF_2 + 6CO.$$

The present application is intended to cover the aforesaid metal carbid or acetylid, (calcium carbid), together with a binder, in the form of an electrode which may be employed, in conjunction with an electric current, to augment the reduction of metals, as covered in the aforesaid Letters-Patent.

Electrodes comprising other metal carbids, acetylids, or other metal-carbon-containing compounds, united or bound together with carbon or other binder, forming a composite metal-carbon-containing electrode of the character aforementioned, instead of calcium carbid or acetylid, such as aluminium carbid, may be provided or exist, without departing from the spirit of my invention, and the term "metal carbid" as employed herein with reference to the character of a species of metal-carbon-containing compound content of the electrode, relates to carbid of electrical conductive nature or of comparatively low electrical resistance in contradistinction to and from non-metal-carbids, such as silicon carbid, which are non-conductors of electricity or so highly resistant as to be practically considered as non-conductors within reasonable bounds. Under metal carbids described and claimed herein, as a constituent of the composite electrode, is included double metal carbids or metal-hydrogen-containing compounds, such as hydrogen and other metal carbid, or such compounds as may be considered as hydrogen carbid (hydrocarbon) in which one or more hydrogens are replaced by another metal, and the acetylids referred to and claimed herein include that species of carbid which yields acetylene upon decomposition with water, and which compound may be considered as acetylene in which hydrogen thereof is replaced by other metal.

The term "metal-carbon-containing compound" employed herein is intended to imply and does imply a distinct chemical compound containing chemically combined elements, of which metal and carbon are essentials, and said expression is to be interpreted to the full extent and with the full meaning of the terms relating to such compounds as broadly set forth in the specification of the original application filed April 18, 1903, Serial No. 153,329, of which the present application is a division as before stated, as being "substances containing metal and carbon, either as carbid, acetylid, or other union," it being obvious that the said metal-carbon-containing compound employed as essential ingredient in the present composite electrode must be a conductor of electricity.

The terms "inviscid" and "fixed" as employed herein with reference to the character of the binder for the metal-carbon-containing compounds, metal carbids, acetylids, or metal acetylids, employed, is intended to imply, and does imply, a binder of self retaining or non-viscous nature, capable *per se* of retaining the constituents against gravity when in use, *i. e.*, not fluid, semi-fluid, or readily fusible or liquefiable under the conditions to which it is to be employed or to which to be subjected during use, as contradistinguishing a fixed carbon binder from a viscous or semi-fluid agglutinizing agent, such as tar or similar liquid, semi-liquid, or liquefiable substances incapable *per se* of retaining the constituents against gravity when suspended.

Having now described my invention what

I claim as new, and desire to secure by Letters Patent is:—

1. An electrode composed of a metal-carbon-containing compound and an inviscid, fixed binder.

2. An electrode containing a metal-carbon-containing compound and an inviscid, fixed binder.

3. An electrode composed of a metal-carbon-containing compound and an electrically conductive binder.

4. An electrode containing a metal-carbon-containing compound and an electrically conductive binder.

5. An electrode composed of a metal-carbon-containing compound and an inviscid, fixed carbon-containing binder.

6. An electrode containing a metal-carbon-containing compound and an inviscid, fixed carbon-containing binder.

7. An electrode composed of a metal-carbon-containing compound and a carbon binder.

8. An electrode containing a metal carbon-containing compound and a carbon binder.

9. An electrode composed of a metal carbid and an inviscid, fixed binder.

10. An electrode containing a metal carbid and an inviscid, fixed binder.

11. An electrode composed of a metal carbid and an electrically conductive binder.

12. An electrode containing a metal carbid and an electrically conductive binder.

13. An electrode composed of a metal carbid and an inviscid, fixed carbon-containing binder.

14. An electrode containing a metal carbid and an inviscid, fixed carbon-containing binder.

15. An electrode composed of a metal carbid and a carbon binder.

16. An electrode containing a metal carbid and a carbon binder.

17. An electrode composed of an acetylid and an inviscid, fixed binder.

18. An electrode containing an acetylid and an inviscid, fixed binder.

19. An electrode composed of an acetylid and an electrically conductive binder.

20. An electrode containing an acetylid and an electrically conductive binder.

21. An electrode composed of an acetylid and an inviscid, fixed carbon-containing binder.

22. An electrode containing an acetylid and an inviscid, fixed carbon-containing binder.

23. An electrode composed of an acetylid and a carbon binder.

24. An electrode containing an acetylid and a carbon binder.

25. An electrode composed of a metal acetylid and an inviscid, fixed binder.

26. An electrode containing a metal acetylid and an inviscid, fixed binder.

27. An electrode composed of a metal acetylid and an electrically conductive binder.

28. An electrode containing a metal acetylid and an electrically conductive binder.

29. An electrode composed of a metal acetylid and an inviscid, fixed carbon-containing binder.

30. An electrode containing a metal acetylid and an inviscid, fixed carbon-containing binder.

31. An electrode composed of a metal acetylid and a carbon binder.

32. An electrode containing a metal acetylid and a carbon binder.

33. An electrode composed of an electrically conductive metal-carbon-containing compound and an inviscid, fixed binder.

34. An electrode containing an electrically conductive metal-carbon-containing compound and an inviscid, fixed binder.

35. An electrode composed of an electrically conductive metal-carbon-containing compound and an electrically conductive binder.

36. An electrode containing an electrically conductive metal-carbon-containing compound and an electrically conductive binder.

37. An electrode composed of an electrically conductive metal-carbon-containing compound and an inviscid, fixed carbon-containing binder.

38. An electrode containing an electrically conductive metal-carbon-containing compound and an inviscid, fixed carbon-containing binder.

39. An electrode composed of an electrically conductive metal-carbon-containing compound and a carbon binder.

40. An electrode containing an electrically conductive metal-carbon-containing compound and a carbon binder.

41. An electrode composed of an electrically conductive metal carbid and an inviscid, fixed binder.

42. An electrode containing an electrically conductive metal carbid and an inviscid, fixed binder.

43. An electrode composed of an electrically conductive metal carbid and an electrically conductive binder.

44. An electrode containing an electrically conductive metal carbid and an electrically conductive binder.

45. An electrode composed of an electrically conductive metal carbid and inviscid, fixed carbid-containing binder.

46. An electrode containing an electrically conductive metal carbid and inviscid, fixed carbon-containing binder.

47. An electrode composed of an electrically conductive metal carbid and a carbon binder.

48. An electrode containing an electric-

ally conductive metal carbid and a carbon binder.

49. An electrode composed of an electrically conductive acetylid and an inviscid, fixed binder.

50. An electrode containing an electrically conductive acetylid and an inviscid, fixed binder.

51. An electrode composed of an electrically conductive acetylid and an electrically conductive binder.

52. An electrode containing an electrically conductive acetylid and an electrically conductive binder.

53. An electrode composed of an electrically conductive acetylid and an inviscid, fixed carbon-containing binder.

54. An electrode containing an electrically conductive acetylid and an inviscid, fixed carbon-containing binder.

55. An electrode composed of an electrically conductive acetylid and a carbon binder.

56. An electrode containing an electrically conductive acetylid and a carbon binder.

57. An electrode composed of an electrically conductive metal acetylid and an inviscid, fixed binder.

58. An electrode containing an electrically conductive metal acetylid and an inviscid, fixed binder.

59. An electrode composed of an electrically conductive metal acetylid and an electrically conductive binder.

60. An electrode containing an electrically conductive acetylid and an electrically conductive binder.

61. An electrode composed of an electrically conductive metal acetylid and an inviscid, fixed carbon-containing binder.

62. An electrode containing an electrically conductive metal acetylid and an inviscid, fixed carbon containing binder.

63. An electrode composed of an electrically conductive metal acetylid and a carbon binder.

64. An electrode containing an electrically conductive metal acetylid and a carbon binder.

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

HENRY SPENCER BLACKMORE.

Witnesses:
J. R. NOTTINGHAM.
CHARLES S. FLETCHER.