

UNITED STATES PATENT OFFICE.

THOMAS L. WILLSON, OF NEW YORK, N. Y.

ELECTRIC SMELTING.

SPECIFICATION forming part of Letters Patent No. 575,788, dated January 26, 1897.

Application filed February 20, 1895. Serial No. 539,143. (No model.)

To all whom it may concern:

Be it known that I, THOMAS L. WILLSON, a citizen of the United States, residing in the city, county, and State of New York, have
5 invented certain new and useful Improvements in Electric Smelting, of which the following is a specification.

This invention relates to the treatment of refractory materials for their reduction by
10 means of the heat generated by the electric arc.

Heretofore electric smelting has been performed by subjecting the material to be reduced, together with the reducing agent, to
15 the heat generated by the passage of a continuous electric current of uniform direction between refractory electrodes to form an electric arc, the one electrode being beneath the mass under treatment and the other electrode
20 being above. Commonly the upper electrode is in the form of a carbon pencil, and the lower one is constituted at the outset by the carbon hearth or bottom of the crucible, and later in the process by the bath or pool of molten reduced material.
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My present invention is based upon the discovery which I have made that by employing the arc generated by a suitable alternating current instead of a continuous current not
30 only is the feeding of the material into the electric furnace greatly facilitated, but the output of material reduced in proportion to the power expended is nearly doubled.

My invention accordingly consists in feeding
35 the material to be reduced in a suitably pulverized or comminuted condition, together with the reducing agent in similar pulverulent condition, into an electric arc formed between two separated electrodes, the one beneath the material and the other above, by
40 an alternating current of appropriate volume and frequency. When, for example, aluminium is to be produced by the reduction of alumina, the powdered alumina is fed, with a
45 powdered carbonaceous material as the reducing agent, into the vicinity of the electric arc.

In practicing my invention for the production of aluminium bronze, for example, I provide, preferably, a Siemens arc furnace with a
50 vertical carbon pencil, and I employ an alter-

nating-current dynamo of suitable frequency, with or without the intervention of a transformer, one terminal of the circuit being connected to the carbon pencil and the other terminal to the crucible or carbon hearth of the
55 furnace. I then take powdered alumina and powdered or crushed carbon (which may be coal-dust or coal-slack) and mix them intimately together in the necessary proportions
60 for reduction. I also supply a suitable amount of copper to form the base metal of the alloy, which may be initially placed in the furnace, or it may be granulated and mixed with the alumina and carbon. The electric furnace
65 having been set in operation, this mixture is then fed into the furnace so as to be introduced around the carbon pencil and in the neighborhood of the arc, whereupon it is immediately set into vibration and progressively
70 drawn into the arc by the pulsations of the latter, whereby the furnace becomes self-stoking so long as the supply of the material to the furnace is maintained. This effect is believed to be due to the alternate expansion
75 and contraction of the gases produced by the arc, whereby the mass is kept in constant and rapid vibration. The intense heat generated by the arc dissociates the oxygen
80 from the alumina, and this oxygen is taken up by the incandescent carbon, forming carbon monoxid or dioxid, which escapes from the furnace, while the aluminium which is set free becomes alloyed with the molten copper,
85 and the resulting alloy or bronze is or may be tapped off from the furnace either continuously or at suitable intervals.

While my invention is not limited to any particular proportions as to the electromotive force or quantity or rapidity of alternation of
90 the electric current, yet I would state as one practicable example of the application of my invention that I have successfully operated it with a current of about fifteen hundred amperes at fifty-five volts with one hundred and
95 twenty alternations sixty cycles per second. Under these conditions I have produced an output nearly double that obtained by the best practice in smelting with continuous currents.

My invention is applicable to the electric
100 reduction of various metals from their ores and to other electric smelting or electrometal-

lurgical operations and is not by any means limited to the one example that I have suggested.

A further specific application of my invention is the reduction of calcium oxid with carbon for producing calcium carbid. For this purpose I take powdered or crushed lime and powdered or crushed carbon and mix them in the proportions of thirty-five per cent. by weight of carbon to sixty-five per cent. of lime and feed them into the furnace, wherein the heat that is generated dissociates the oxygen from the calcium and both combine with the carbon, forming, on the one hand, carbon monoxid or dioxid, which escapes from the furnace, and, on the other hand, calcium carbid, which is tapped off at intervals. This process I do not specifically claim in my present application, as it is specifically the subject of another application which I have already filed, issued as Patent No. 541,137, dated June 18, 1895. It constitutes a species within the genus claimed in my present application.

My present invention, by reason of the greatly-increased output for a given expenditure of energy, results in a very marked economy in the conduct of electric smelting operations, and also by reason of the self-feeding or automatic stoking due to the alternating current is found practically to greatly facilitate the conduct of the electric smelting operation.

I claim as my invention—

1. The process of electric smelting which consists in subjecting the material to be treated in pulverulent condition to the continued action of an electric arc formed between separated electrodes, by feeding such material into the immediate neighborhood of the arc, and maintaining the arc by an alternating current of a frequency adapted to set the mass of material into vibration, whereby by the pulsations of the arc the material is progressively drawn within its influence.

2. The process of electric smelting which

consists in subjecting the material to be treated in pulverulent condition to the continued action of an electric arc formed between separated electrodes, consisting the one of a pool of molten material beneath and the other of a carbon electrode above, so that the inter-polar space is approximately horizontal, by feeding such material upon such pool, around the carbon electrode and into the immediate neighborhood of the arc, and maintaining the arc by an alternating current of a frequency adapted to set the mass of material into vibration, whereby by the pulsations of the arc the material is progressively drawn within its influence.

3. The process of recovering aluminium from its ores or compounds, which consists in feeding the aluminous material and carbonaceous material in a pulverulent condition into the neighborhood of an electric arc formed between separated electrodes by an alternating current of appropriate volume and frequency adapted to set the mass of material into vibration, whereby by the pulsations of the arc the materials are progressively drawn within its influence.

4. The process of producing an aluminium alloy, which consists in feeding alumina and carbon in pulverulent condition into the neighborhood of an electric arc formed by an alternating current between a molten bath of base metal and a carbon electrode above and out of contact with said bath, the alternating current being of appropriate volume and frequency adapted to set the mass of material into vibration, whereby by the pulsations of the arc the materials are progressively drawn within its influence.

In witness whereof I have hereunto signed my name in the presence of two subscribing witnesses.

THOMAS L. WILLSON.

Witnesses:

THOMAS F. WALLACE,
GEORGE H. FRASER.