UNITED STATES PATENT OFFICE.

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PROCESS OF ELECTRIC SMELTING FOR OBTAINING ALUMINIUM.

SPECIFICATION forming part of Letters Patent No. 324,659, dated August 18, 1885.

Application filed April 23, 1885. (No specimens.)

To all whom it may concern:

Be it known that we, EUGENE H. COWLES, ALFRED H. COWLES, and CHARLES F. MABERY, citizens of the United States, residing at Cleveland, in the county of Cuyahoga and State of Ohio, have invented a certain new and useful Improvement in Process of Electric Smelting for Obtaining Aluminium; and we do hereby declare the following to be a full, clear, and exact description of the invention, such as will enable others skilled in the art to which it appertains to make and use the same.

This invention relates to the reduction of aluminous ores and the production of aluminium by electricity.

Heretofore many processes have been proposed by others for the reduction of aluminium, but they have been too expensive to allow the metal to be produced at a price low enough for it to come into extensive and general use, and in prior patents, Nos. 319,945 and 319,795, of June 9, 1885, by two of the undersigned, an electric furnace and process of reducing ores have been described, by means of which aluminium, as well as other refractory ores, can be economically reduced. Ores are reduced in said furnace by mixing them with broken or granular carbon and passing an electric current through a charge of the mixed ore and carbon; but the product thereby obtained, when an ore of aluminium is reduced, contains a considerable percentage of carbon, which is taken up both chemically and mechanically by the aluminium; and the object of the present invention is to provide a process whereby the aluminium can be obtained free from carbon and in a pure metallic state. This we accomplish by reducing the ore of aluminium in company with tin, copper, manganese, or other metal which will alloy with the aluminium, and then subsequently separating the alloying metal from the aluminium by amalgamation, lixiviation, or equivalent process, leaving the residue aluminium in the form of an amorphous powder or state, which can be melted down into an ingot. When aluminium is alloyed with either of the metals above named it takes up very little, if any, of the carbon, whereas the pure aluminium will, as above stated, absorb a very considerable percentage of carbon, more even than iron or any of the other metals. We thus obtain an alloy free from carbon, and the constituent elements of the alloy may be separated in several ways—for example, in some cases by amalgamation and in others by lixiviation.

To produce aluminium according to this process, a charge of the pulverized ore of aluminium and carbon mixed is reduced by means of an electric current in company with the alloying metal, and this step in the process is fully described in an application filed by E. H. Cowles and A. H. Cowles on the 7th of April, 1885. The product thereby obtained is an alloy of aluminium with tin, manganese, or such other metal as may be preferred, but either tin or manganese are preferably used, and the alloy is substantially free from carbon chemically combined therewith. The alloy as it comes from the furnace has pieces of the carbon attached to and embedded in it, and the carbon thus mechanically united with the alloy is easily removed by crushing the mass and washing.

When the aluminium is alloyed with tin, silver, copper, or other easily-amalgamated metal, the two metals are easily separated by amalgamation in the same manner that gold or silver ores are amalgamated. The mercury takes up the alloying metal and leaves the aluminium untouched, and the amalgamation may be effected either with or without the use of sodium amalgam, acid, electricity, or heat to assist and quicken the amalgamation. If manganese or some other readily soluble metal—as zinc or copper—is used, then any lixiviation process may be employed that will leach out the alloying metal.

The alloy may be broken into small pieces and placed in a suitable vessel, through which a lixiviating liquid—such as nitric acid and water—is caused to flow and leach out the manganese from the alloy, the aluminium not being touched by the lixiviation process; and the said lixiviation may be assisted by other acids, heat, or electricity, as the case may require. In both cases the residue is aluminium in the form of an amorphous powder, and this is easily melted into an ingot.

We do not confine the use of the hereinbefore described process to the production of aluminium, as the same method may be followed to obtain other like metals, and also metalloids—such as silicium and boron.

We are aware that it has been heretofore proposed to reduce aluminium ores by smelting them with zinc ores and then separating the two metals, and that the alkaline earths have been reduced by electrolysis in contact with an alloying metal and plates of carbon or platinum, and the alloyed metals thus produced subsequently separated. We do not, therefore, claim the same, broadly; but

What we do claim as our invention, and desire to secure by Letters Patent, is—

1. The method of producing aluminium which consists in reducing an ore or compound of aluminium in company with an amalgamating metal by means of electricity and in the presence of carbon, substantially as described, and then separating the two metals of the alloy by amalgamation.

2. The method of producing aluminium which consists of mixing the aluminium ore with carbon and with a metal, reducing the said ore by means of electricity, so that the aluminium forms an alloy with the said metal, and finally separating the two metals of the alloy, substantially as set forth.

3. The method of producing aluminium which consists of mixing the aluminium ore with broken carbon and with a metal, reducing the said ore by means of electricity, so that the aluminium forms an alloy with the metal, and finally separating the aluminium from the alloy by amalgamating the said metal, substantially as set forth.

In testimony whereof we affix our signatures in presence of two witnesses.

EUGENE H. COWLES.
CHARLES F MABERY.
ALFRED H. COWLES.

Witnesses:
A. R. SCOTT,
E. H. PERDUE.