

(No Model.)

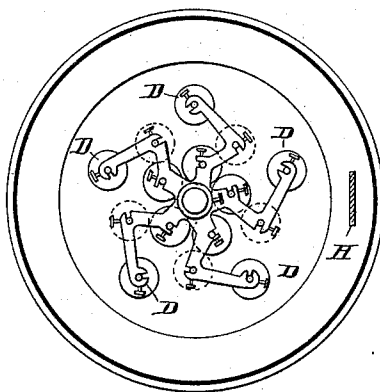
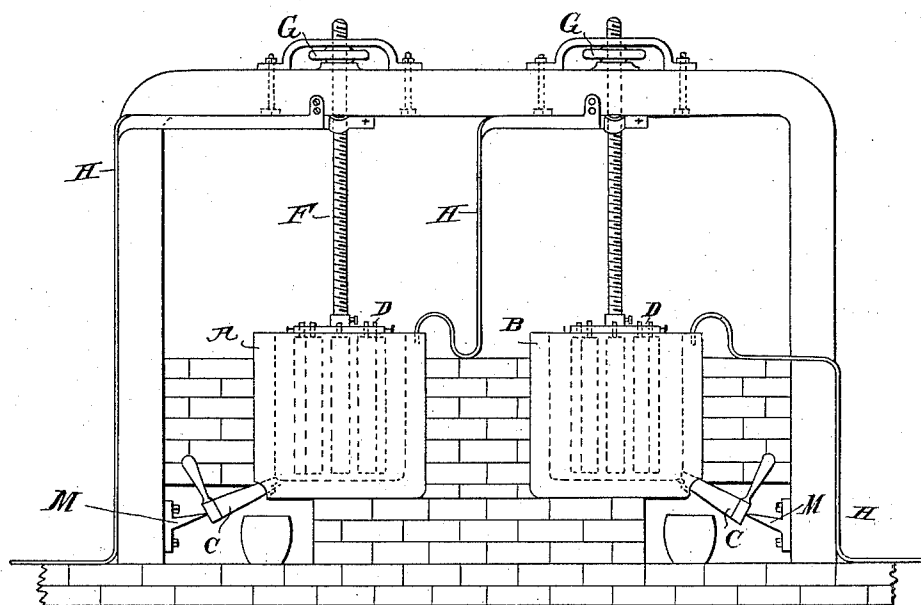
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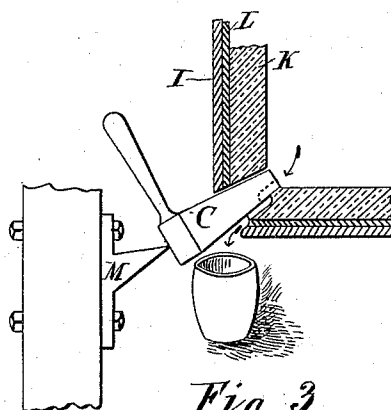
No. 476,256.

Patented June 7, 1892.

*Fig. 1.*



*Fig. 2.*



*Fig. 3.*

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Clerk.

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# UNITED STATES PATENT OFFICE.

MICHAEL EMME, OF ATLANTA, GEORGIA.

## METHOD OF AND APPARATUS FOR EXTRACTING ALUMINIUM.

SPECIFICATION forming part of Letters Patent No. 476,256, dated June 7, 1892.

Application filed September 28, 1891. Serial No. 407,001. (No model.)

*To all whom it may concern:*

Be it known that I, MICHAEL EMME, a citizen of the United States, residing at Atlanta, in the county of Fulton and State of Georgia, have invented certain new and useful Improvements in Methods of and Apparatus for Extracting Aluminium; and I 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.

My invention involves an improved method of and apparatus for producing aluminium. The most economical method of manufacturing aluminium now practiced involves the use of electricity for maintaining the salt or compound of aluminium in fusion while it is decomposed and the metal separated from the other elements of the compound.

My invention involves a combined chemical and electrical decomposition of the aluminium compound. In carrying it into practice I preferably use a compound wound constant-potential generator of electricity of about eighty-one electrical horse-power, the generator being self-regulating and developing a current of two thousand four hundred amperes and twenty-five volts and a speed of three hundred and fifty revolutions per minute. A current from this machine is caused to traverse a fused solvent in which alumina is placed, this solvent reducing the conductivity and promoting the quality and quantity of aluminium produced. The solvent I prefer to use is composed of fluoride of aluminium and chloride of aluminium mixed dry in the proportion of ten parts of the former to one part of the latter ( $10\text{Al}_2\text{F}_6 + \text{Al}_2\text{Cl}_6$ ). This material is inserted between carbon electrodes and an aresprung, which fuses it, after which alumina is introduced, when the process can be carried forward continuously.

In the accompanying drawings I have shown a form of apparatus well adapted for carrying out my process.

Figure 1 represents a side elevation, partly in section, of such apparatus. Fig. 2 is a plan view of one of the crucibles, and Fig. 3 is a detail enlarged view of a portion of the pot or crucible where the aluminium is drawn off after reduction.

Two crucibles are preferably used, (shown

in the drawings at A and B and connected in series.) These crucibles are cylindrical cast-iron vessels having a wall I three-quarters of an inch thick and provided with a gas carbon lining K five inches thick; insulated from the iron by asbestos and bauxite-paste L. (See Fig. 3.) The carbon lining constitutes the negative electrode. Each crucible at or near the bottom is provided with a draw-off cock C of carbon mounted in the crucible and provided with an iron handle, so that melted aluminium may be readily withdrawn when occasion requires.

M indicates a pivotal point of support for the cock. The positive electrodes are composed of a group of carbon cylinders D, suspended from the frame by a threaded support F, which may be raised or lowered vertically by the hand-wheel G. Heavy copper bars H I are used for leading the current first to the carbon anode of the first crucible and then from the lining of the crucible to the carbon anode of the second crucible. The positive electrodes or anodes are formed of cylindrical blocks of carbon and are held by screws in a cast-copper electrode-holder, so arranged that the cylinders may be given a different grouping or arrangement, so as to vary the electrical resistance of the crucible during the progress of the operation of reduction. When the cylinders are all arranged centrally on the holder, the distance from the cylinders to the wall of the crucible is greatest and the resistance at a maximum. The ready-prepared and thoroughly-mixed dry solvent is introduced into the crucibles at the beginning of the operation. The chloride of aluminium adds to the fusibility of the fluoride and becomes a poor conductor. The positive electrodes are adjusted into contact with the bottom of the crucible at starting and then raised so as to spring an arc, which acts upon and fuses the compound solvent.

The apparatus might be used to decompose alumina alone without the use of the solvent if the interior resistance of the generator is as low as three thousandths of an ohm; but my experiments demonstrate that alumina becomes too good a conductor of electricity, so that its internal resistance becomes much lower than the generator and the economy of the process of reduction is lowered. By the

use of the solvent compound the resistance of the bath is continuously maintained in a good working condition. The poor conductivity of the fused solvent prevents its rapid decomposition, so that only a small amount of the solvent is decomposed and but a slight addition is needed after several days' work. After the arc is established between the positive and negative electrodes the dry solvent is introduced into the crucible by a small shovel, both crucibles being filled. After about five hours continuance of the current fusion will be indicated by variations of an ampère-meter in the circuit, the resistance gradually decreasing. The positive electrodes are then gradually raised until the distance between the bottom of the crucibles and the bottom surface of the positive electrodes will be about the same or a little less than the distance between the electrodes and the side of the crucible. In less than ten hours fusion will be completed. Then about four pounds of calcined hot alumina is introduced into the crucibles and the process continued until the ampère-meter indicates about two ampères for each square centimeter of surface of the positive electrodes exposed to the current in the fused solvent. The outer positive cylinders are then disconnected from the spider or holder and brought toward the central group, so as to arrange them together and maintain them at a maximum distance from the lining of the crucible, and in case of further increase of conductivity the positive electrode should be raised by its adjusting-screw until the distance to the bottom of the crucible is equal to the distance to the side wall. The alumina sinks to the bottom of the crucible, and is decomposed by a combined chemical and electrolytic means, the carbon at the high temperature developed having a very strong affinity for the oxygen and freeing the metal

from the alumina. The operation should be continued as long as carbonic gas is given off in any considerable quantity, after which a second portion of calcined alumina should be added, and the same operation repeated. The pure metal may be withdrawn from the draw-off cock and run into molds and cast into bars or any form desired. When reduced in accordance with the process herein described, no deposition of carbon (black substance) or formation of the oxides of the alkalis or alkaline metals is formed, as in other electrical processes of aluminium reduction now practiced.

Having thus described my invention, what I claim as new, and desire to secure by Letters Patent, is—

1. The process of extracting aluminium from its oxides, consisting in leading a decomposing electric current through a fused mass of fluoride and chloride of aluminium to which free alumina has been added.

2. The process for the reduction of aluminium, consisting of fusing electrically a solvent composed of fluoride and chloride of aluminium in proportions specified, introducing into this solvent hot calcined alumina and maintaining uniform the resistance of the fused mass during decomposition.

3. As an apparatus for reducing metals from their ores, a generator of electricity combined with a cup-shaped negative electrode and a positive electrode provided with regulating devices for varying its distance from the bottom and sides of the cup-shaped cavity.

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

MICHAEL EMME.

Witnesses:

FRANK E. ELLIS,  
N. R. FOWLER.