UNITED STATES PATENT OFFICE.

RICHARD GRÄTZEL, OF BREMEN, GERMANY, ASSIGNOR TO THE ALUMINIUM UND MAGNESIUM FABRIK PATENT GRÄTZEL, OF SAME PLACE.

PRODUCTION OF ALUMINIUM AND ALUMINIUM BRONZE.

SPECIFICATION forming part of Letters Patent No. 362,441, dated May 3, 1887.

Application filed December 7, 1885. Serial No. 184,986. (No specimens.)

To all whom it may concern:

Be it known that I, RICHARD GRÄTZEL, a subject of the King of Prussia, and residing at Bremen, German Empire, have invented new and useful Improvements in the Production of Aluminium and Aluminium Bronze, of which the following is a specification.

My invention relates to the production of aluminium from the compound fluoride of aluminium and of an alkali metal; and it consists in decomposing the aluminium fluoride of the said compound when being in melted condition by means of magnesium, which may be employed in prepared state as metal or formed in the bath of the melted fluoride by the electric decomposition of magnesium chloride. If the electric current is called into aid, the said magnesium chloride may be replaced by chloride of calcium, barium, or strontium.

The invention also comprises the production of aluminium bronze by the introduction of copper into the melted bath from which the aluminium is obtained. If the compound fluoride of aluminium and of an alkali metal (especially of potassium or sodium) is melted and exposed to the action of magnesium, fluoride of magnesium is formed and aluminium separates out in metallic state. The simplest mode of proceeding is to add magnesium in solid or fused condition to the melted fluoric compound. At the beginning of the operation it is advantageous in such case to promote the mixture of the magnesium with the melted salt by stirring; but the magnesium may also first be evaporated in a closed vessel, the vapor produced being conducted through a tube into the melted fluoric salt.

The third manner of carrying out the invention consists in producing the magnesium during the process by electrolysis of chloride of magnesium. As is well known, this salt may be decomposed in fused state by the electric current, chlorine being evolved at the positive pole, while the metal is deposited at the negative pole. Now, if the compound fluoride of aluminium and of an alkali metal is melted together with chloride of magnesium, (preferably in the proportion of three equivalents of the chloride to one equivalent of fluoride of aluminium contained in the fluoric salt,) and if an electric current of sufficient strength is conducted through the molten mass, the said current decomposes the chloride of magnesium, chlorine is evolved, the magnesium combines in nascent state with the fluorine of the aluminium fluoride, and metallic aluminium separates out.

As fluoric compounds of aluminium may be used native cryolite, (Al_2F_6+6NaF,) or an artificial compound fluoride of aluminium and of an alkali metal. Moreover, it is to be observed that, instead of simple chloride of magnesium, the compound chloride of magnesium and potassium or sodium—for instance, carnallite—or a mixture of magnesic and potassic or sodic chlorides, may be employed with advantage, inasmuch as the fused mass will thereby become more fluid.

In comparison with the direct production of aluminium from the melted aluminium fluoride by electrolysis, to which relate my German Patent No. 26,962, and the British Patent No. 5,509, A. D, 1882, or from the double fluoride of aluminium and of an alkali metal, the process described in the foregoing presents the advantages that it may be carried out with an electric current of lower tension, and that the crucibles employed in the operation are not or but very little corroded (especially in the presence of chloride of potassium or sodium) by the fluoride of magnesium, or of magnesium and an alkali metal formed in the process, whereas the fluorine or comparatively pure fluoride of potassium or sodium produced by the former method acts in a high degree destructively on the crucibles. The latter advantage is also of importance in respect to the employment of metallic magnesium, as compared with the decomposition of fluoride of aluminium by means of sodium. In like manner, as by magnesium, the decomposition of fluoride of aluminium may be brought about by means of calcium, barium, and strontium; but on account of the great difficulties which the production of these metals present, their employment in reguline state would, for the present at least, not be adapted to make the process remunerative. The chlorides of calcium, barium, and strontium may, however, be used, instead of chloride of magnesium, for

decomposing the fluoride of aluminium with the assistance of electricity. If, in addition to magnesium, copper is introduced into the melted compound fluoride, the same combines with the aluminium as it separates out and forms therewith aluminium bronze. In the electrolytic process a negative electrode consisting of copper may be used for this purpose.

I am aware that it has been proposed to obtain aluminium by subjecting anhydrous chloride or aluminium, the double chloride of aluminium and ammonium, the double chloride of aluminium and sodium, the double fluoride of aluminium and sodium to the action of heat and electrolytic action simultaneously. I am also aware of a process of reducing metals by electrolysis, in which a mixture of compounds is used to increase the conductivity of the electrolyte or to lower the point of fusion—*e. g.*, the addition of calcium chloride to potassium chloride or sodium chloride. I am further aware that it is not new to manufacture two metals—for instance, sodium and aluminium—simultaneously from a double salt; and, still further, I am aware that it has been proposed, in the production of aluminium from the double chloride of aluminium and sodium by electrolysis, to add chloride of sodium, in order to allow the process to be carried out at a higher temperature; but such processes as above named are not the equivalent of my invention, and are very dissimilar thereto, for the reason that in said processes the very essential ingredient, chloride of magnesium, as an accessory in the manufacture of aluminium from the double fluoride of aluminium and sodium, is not employed; and therefore I do not wish to claim, broadly, any features of the said processes as my invention; but

What I claim, and desire to secure by Letters Patent, is—

1. The process of producing aluminium from the compound fluoride of aluminium and of an alkali metal by melting the said compound fluoride together with chloride of magnesium, or one of its aforesaid equivalents, (chloride of calcium, of barium, and of strontium,) and by causing an electric current to act on the molten mass, substantially as and for the purpose described.

2. The process of producing aluminium bronze from the compound fluoride of aluminium and of an alkali metal and from copper by melting the said fluoride together with chloride of magnesium, or one of its aforesaid equivalents, (chloride of calcium, of barium, and of strontium,) by introducing copper into the molten mass and by causing an electric current to act on the said mass, substantially as and for the purpose specified.

In testimony whereof I have hereunto set my hand in the presence of two subscribing witnesses.

RICHARD GRÄTZEL.

Witnesses:
CHAS. A. ALBERTI,
PAUL ROSTOCK.