UNITED STATES PATENT OFFICE.

GUILLAUME DE CHALMOT, OF LEAKSVILLE, NORTH CAROLINA, ASSIGNOR TO THE WILLSON LABORATORY COMPANY, OF NEW YORK, N. Y.

SILICON ALLOY.

SPECIFICATION forming part of Letters Patent No. 589,415, dated September 7, 1897.

Application filed May 14, 1896. Serial No. 591,514. (Specimens.)

To all whom it may concern:

Be it known that I, GUILLAUME DE CHALMOT, a subject of the Queen of the Netherlands, who have declared my intention of becoming a citizen of the United States, residing in Leaksville, in the county of Rockingham and State of North Carolina, have invented certain new and useful Improvements in Silicon Alloys and their Manufacture, of which the following is a specification.

My invention relates to the production of alloys of silicids of metals with crystalline silicon.

I take a silicon compound, such as silica or a silicate, a metal or metallic compound, such as a metallic oxid or salt, (or a mixture of metals or their compounds,) and a carbonaceous reducing agent, and I heat them in an electric furnace with a direct current of high amperage and sufficient voltage, preferably, to maintain only a small arc. It is often well to start with a higher voltage and maintain a strong arc until some of the mixture has become molten, when the voltage can be decreased and the amperage may be increased. At the end of the operation the cathode will be found covered with a metallic-looking mass, which consists of an alloy of crystalline silicon with a high-grade silicid of the metal or metals whose oxids have been used. From this alloy I can readily obtain the silicon in pure condition by dissolving out the metallic silicids by use of any solvent thereof. To do this, the alloy is preferably boiled with hydrochloric or sulfuric acid or other strong acids and then treated with hydrofluoric acid and washed, whereby the silicids are dissolved out and the crystalline silicon remains. In this way pure crystalline silicon can be obtained at very moderate cost.

In working my process I have obtained silicon from an alloy of calcium silicid and silicon and from an alloy of manganese silicid and silicon. I have also with the same electric-furnace process prepared high-grade silicids or alloys thereof of the following composition: calcium silicid containing eighty-one per cent. silicon, manganese silicid containing seventy-one per cent. silicon, and iron silicid containing sixty-nine per cent. silicon. I have also produced silicon alloys of tungsten and silver containing free crystalline silicon.

Crystalline silicon such as is produced by my process is useful as a reducing agent and for other purposes. Some metals are improved by the introduction of a small amount of silicon, which may be effected by melting the metal with the silicon. In many instances it will not be necessary to obtain the pure silicon if it is to be used to reduce a metal, or to be added to a metal, as for such purpose it will usually answer quite as well to use a high-grade silicid of the metal in question alloyed with crystalline silicon, such as can be easily and cheaply made by my process, whereby the expense of the subsequent dissolving out of the silicid is avoided.

I have found that when a mixture of silica, a metallic oxid, and carbon is subjected to the smelting action of an electric-arc furnace fed by an alternating current the product becomes largely a carbid of the metal. This is especially true in case the metallic oxid is lime, in which case the reduced calcium is almost wholly converted into calcium carbid; but with a direct current the same mixtures yield the silicids and silicon in preference to the carbids. This fact indicates that in producing high-grade silicids and silicon some part is played by electrolytic action.

The high-grade crystalline silicids of metals which are produced by my process have usually the formula $MeSi_2$—as, for example, $CaSi_2$, calcium silicid; $FeSi_2$, iron silicid; $MnSi_2$, manganese silicid. With these silicids there is alloyed in the product a greater or less proportion of free ununited silicon.

For separating the silicids from the silicon instead of using hydrofluoric acid the silicic acid which is formed when the silicids are treated with hydrochloric or sulfuric acid can in some cases (for example, in the case of calcium silicid) be separated from the silicon by running water, since owing to the less specific gravity of the silicic acid it can be washed away, or it may be dissolved in alkali solutions.

The references herein to "metallic" silicids or compounds and to "metals" are on the usual assumption that silicon is not a metallic

element. If, however, silicon is held to be a metal, these expressions are to be understood as meaning that the metal referred to is a metal other than silicon.

I claim as my invention the following-defined novel features, substantially as hereinbefore specified, namely:

1. The described new product consisting of an alloy of silicon with a metallic silicid.

2. The described process consisting in subjecting a material or materials containing a metal and silicon, with carbonaceous matter, to the action of an electric furnace with a direct current, until the carbonaceous matter is eliminated by the reduction of said materials, whereby is produced an alloy of silicon with a silicid of the metal.

3. The improved process of producing crystalline silicon which consists in first producing an alloy of silicon with a metallic silicid, and then treating the alloy with a solvent of the silicid to dissolve away the latter.

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

G. DE CHALMOT.

Witnesses:
W. T. COLEMAN,
J. E. WILLIAMS.