

# UNITED STATES PATENT OFFICE.

GEORGE O. SEWARD AND FRANZ VON KÜGELGEN, OF HOLCOMBS ROCK, VIRGINIA, ASSIGN-  
ORS TO VIRGINIA LABORATORY COMPANY, OF NEW YORK, N. Y., A CORPORATION OF  
NEW YORK.

## REDUCTION PROCESS FOR PRODUCING METALS AND ALLOYS.

No. 908,154.

Specification of Letters Patent.

Patented Dec. 29, 1908.

Application filed March 28, 1906. Serial No. 308,455.

*To all whom it may concern:*

Be it known that we, GEORGE O. SEWARD, a citizen of the United States, and FRANZ VON KÜGELGEN, a subject of the German Emperor, both residents of Holcombs Rock, in the county of Bedford and State of Virginia, have jointly invented certain new and useful Improvements in Reduction Processes for Producing Metals and Alloys, of which the following is a specification.

This invention relates to the thermic reduction of metallic oxids or other compounds, whereby to produce the metal thereof in pure state, or in the form of an alloy with another metal. For this purpose aluminum has been used as a reducing agent, both in comminuted form intimately commingled with the oxid, sulfid or other compound to be reduced, or in molten condition. Practically the use of powdered aluminum mixed with the compound to be reduced is preferable, but the process is rendered very expensive because of the high price of aluminum and the expense of reducing it to powdered form. Aluminum is not brittle and cannot be crushed, so that to powder it is a very expensive process.

The present invention provides a substitute for finely divided aluminum as a reducing agent in such thermic reactions. We have discovered that alloys of the alkali-earth metals with suitable proportions of either aluminum, magnesium, zinc, or other suitable alloying metals, form brittle alloys which are easily crushed and form a very effective reducing material, which is much cheaper than finely divided aluminum. When such powdered alkali-earth metal alloy is mixed with the finely divided metallic compound to be reduced, and the reaction is started at one portion of the mixture, it will diffuse itself throughout the mass, exactly as in the case of aluminum powder mixed with the substance to be reduced. Or the reaction can be started by heating first a small amount of the mixture and introducing the remainder of the mass gradually as the reaction progresses.

As alkali-earth metals, we may use barium, strontium or calcium, either singly or combined. As the metal to be alloyed therewith we may use aluminum, magnesium, zinc, silicon, or other metals, singly or combined. The condition essential for cheapness, is to

select a metal not too costly in itself which will form a brittle alloy with the alkali-earth metal. This alloy may then be crushed to powder by any suitable means.

The selection of the non-alkali-earth metal should depend upon the use to be made of the brittle alloy. If we wish to produce a pure metal, we use as an alloying metal one which will react with the metallic compound to be reduced. If we wish to produce an alloy, we use as the alloying metal one with which we wish to alloy the metal of the compound to be reduced.

As an example of the production of a pure metal, we instance the reduction of pure chromium from chromium oxid. As the reducing alloy we may use calcium, magnesium or other combination, both components of which enter into the reaction, that is, in this instance both will combine with the oxygen of the oxid.

As an example of the production of an alloy, we will assume the producing of German silver from nickel oxid and cupric oxid. For this we would use as a reducing agent a calcium-zinc alloy, of which the calcium only enters into the reaction, while the zinc alloys with the reduced copper and nickel to make German silver. As further examples, we mention the production of magnesium-aluminum alloys by using as the brittle reducing alloy calcium-magnesium, and as the compound to be reduced magnesium chlorid; in the reaction the calcium takes up the chlorin, freeing the magnesium, which then alloys with the aluminum. Or for producing pure metals we can use the same metal that is to be reduced as the non-alkali-earth ingredient of the brittle alloy. For example to produce magnesium we may reduce magnesium chlorid with a brittle alloy of calcium-magnesium, where the calcium is the reducing agent and the magnesium is used only for the purpose of making the alloy brittle, and for which purpose only so much magnesium as will render it sufficiently brittle, need be used.

For alloying with an alkali-earth metal or metals, we may use two or more alloying metals which may or may not enter into the reaction with the compound to be reduced, and may result in the production of either pure metals or alloys according to the alloying metals chosen with reference to the com-



pound to be reduced. For example if we want to make pure aluminum, we can use as the reducing alloy calcium-magnesium-aluminum, of which both the calcium and the magnesium are consumed in the reduction, freeing the aluminum of the alloy to commingle with the reduced aluminum.

We believe ourselves to be the originators of the following alloys, which in suitable proportions are brittle and are highly useful as reducing alloys, viz:—barium-magnesium, strontium-magnesium, strontium-aluminum.

Our invention is not confined to the specific alloys herein mentioned, but extends to any alloys of the same generic character and having analogous properties.

The novel alloys herein set forth are claimed in a separate application for patent, filed May 14, 1907, Serial No. 373,630.

We claim as our invention:—

1. The process of producing a metal or alloy from a metallic compound, not in the metallic state, which consists in reducing such compound by means of an alloy of an alkali-earth metal and another suitable metal.

2. The process of producing a metal or alloy from a metallic compound, not in the

metallic state, which consists in reducing such compound by commingling with it a powdered alloy of an alkali-earth metal and another suitable metal in such proportion as to render the alloy brittle, and heating such mixture to ignition.

3. The process of producing a metal or alloy from a metallic compound, not in the metallic state, which consists in reducing such compound by means of an alloy of an alkali-earth-metal and another suitable metal which is adapted to react with such compound.

4. The process of producing an alloy from a metallic compound, not in the metallic state, which consists in reducing such compound by means of an alloy of an alkali-earth-metal and another suitable metal which is one of the constituents of the desired alloy.

In witness whereof, we have hereunto signed our names in the presence of two subscribing witnesses.

GEORGE O. SEWARD.

FRANZ VON KÜGELGEN.

Witnesses:

F. V. BIDLER,

J. H. WEBB.