

UNITED STATES PATENT OFFICE.

FRANZ VON KÜGELGEN AND GEORGE O. SEWARD, OF HOLCOMBS ROCK, VIRGINIA,
ASSIGNORS TO VIRGINIA LABORATORY COMPANY, OF NEW YORK, N. Y., A CORPO-
RATION OF NEW YORK.

PROCESS OF PRODUCING MAGNESIUM.

No. 880,489.

Specification of Letters Patent.

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Application filed June 9, 1905. Serial No. 264,505.

To all whom it may concern:

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

This invention relates to the production of magnesium and magnesium alloys by electrolysis.

The present commercial process for the production of metallic magnesium consists in the electrolysis of the double chlorid of magnesium and sodium (or potassium). It is very difficult to obtain the electrolyte free from water. The best results are obtained by mixing chlorid of magnesium with chlorid of sodium or of potassium, and carefully drying this mixture and melting it. After certain other treatments the molten salt is poured into iron crucibles and subjected to an electrolyzing current while applying heat externally. To get good results, the temperature has to be kept low and watched very carefully. If it rises too high, the magnesium is redissolved in the electrolyte; and furthermore the magnesium rises to the top where it is partly burned by exposure to the air, and partly recombines with the chlorine. Even where the proper temperature is maintained, the difference in specific gravity is so slight that it is necessary to use diaphragms of porcelain, which are expensive and fragile. Another disadvantage is that after a certain amount of magnesium has been removed by electrolysis, the electrolyte contains too much sodium or potassium for continuing the process; it then becomes necessary to remove it and replace it by fresh electrolyte. Thus the preparation of the electrolyte requires a long and tedious treatment; and the electrolytic process is not continuous, requires great care, and necessitates the use of expensive diaphragms. Under these conditions it has been heretofore impossible to produce magnesium at a low price, although the raw material is cheap.

The present invention eliminates the disadvantages of the prior process, and renders it possible to produce magnesium by a con-

tinuous process, and at a considerably lower cost than heretofore.

Our invention is based upon the discovery that magnesium oxid or analogous magnesium compound is soluble in certain fluorids of higher decomposition voltage, so that when such fused bath is subjected to electrolysis the magnesium compound alone is decomposed and magnesium is separated at the cathode. We have found that a continuous electrolytic production of magnesium is possible by the use as an electrolyte of a fused mixture of magnesium oxid and magnesium fluorid, rendered fusible by the addition of a fluorid or fluorids of metals more electro-positive than magnesium. Magnesium oxid has a lower decomposition voltage than magnesium fluorid and the other fluorid or fluorids, and is therefore decomposed in preference to the other compounds, so long as the voltage is kept within certain limits, and a proper concentration is maintained. By feeding magnesium oxid to the electrolyte in proportion as it is decomposed, the process may be carried on continuously. In case the voltage is higher than the normal, some magnesium fluorid is also decomposed, but this is easily replaced by the addition of magnesium fluorid during the electrolysis.

In practicing the process, the solvent bath may be considerably varied. The mixture is chosen with a view of getting as low a melting point as possible consistent with the property of dissolving magnesium oxid. A mixture of magnesium fluorid with one or more alkaline fluorids is suitable. Or magnesium fluorid, one or more alkaline fluorid, and one or more alkaline earth fluorids may be used. A mixture of two parts magnesium fluorid, one part lithium fluorid and one part calcium fluorid gives good results.

Instead of magnesium oxid, we may use magnesium oxy-chlorid or other oxy-compound which will dissolve in the solvent baths already described. In case the oxy-chlorid is used, both oxygen and chlorine are separated at the anode. Hereinafter, whenever we designate magnesium oxid, it is understood that we include the oxy-chlorid of magnesium or any other suitable oxy-compound.

An example of an application of our invention is as follows:—A mixture of CaF_2

and MgF_2 in any suitable proportions is melted in a suitable vessel, and when sufficiently molten, MgO is dissolved therein. Or the solvent bath may be made of any of the fluorids referred to, and may or may not include a lithium compound, preferably lithium fluorid. The combined bath is subjected to electrolysis in any suitable and known manner. Carbon anodes may be used and an iron cathode, but other materials may be used for the anode and cathode. As the magnesium oxid is decomposed it is to be replaced by feeding in fresh magnesium oxid. It is desirable to keep the bath nearly saturated with the magnesium oxid, and the latter should therefore be fed in at frequent intervals, and as much or nearly as much as will freely dissolve.

If it is desired to produce an alloy of magnesium, we may use the alloying metal as the cathode, with which the separated magnesium alloys, using for example aluminium, as set forth in our application Serial No. 257,618, filed April 27, 1905.

We claim as our invention:—

1. The process of producing magnesium which consists in dissolving magnesium oxid in a fused bath of mixed fluorids whose decomposition voltage is higher than that of magnesium oxid, subjecting the same to electrolysis, and feeding magnesium oxid to replace that which is decomposed.

2. The process of producing magnesium which consists in dissolving magnesium oxid in a fused bath of magnesium fluorid and another fluorid whose decomposition voltage

is higher than that of magnesium oxid, subjecting the same to electrolysis, and feeding magnesium oxid to replace that which is decomposed.

3. The process of producing magnesium which consists in dissolving magnesium oxid in a fused bath of magnesium fluorid and one or more alkaline fluorids, subjecting the same to electrolysis, and feeding magnesium oxid to replace that which is decomposed.

4. The process of producing magnesium by dissolving magnesium oxid in a fused bath of magnesium fluorid and one or more fluorids of metals more electro-positive than magnesium, and subjecting the same to electrolysis.

5. The process of producing magnesium by dissolving magnesium oxid in a fused bath containing magnesium fluorid and one or more alkali fluorids, and subjecting the same to electrolysis.

6. The process of producing magnesium by dissolving magnesium oxid in a fused bath of magnesium fluorid and one or more alkali fluorids, containing one or more alkaline-earth fluorids, and subjecting the same to electrolysis.

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

FRANZ VON KÜGELGEN.
GEORGE O. SEWARD.

Witnesses:

GEO. T. LANCASTER,
C. OFFERHAUS.