

No. 880,760.

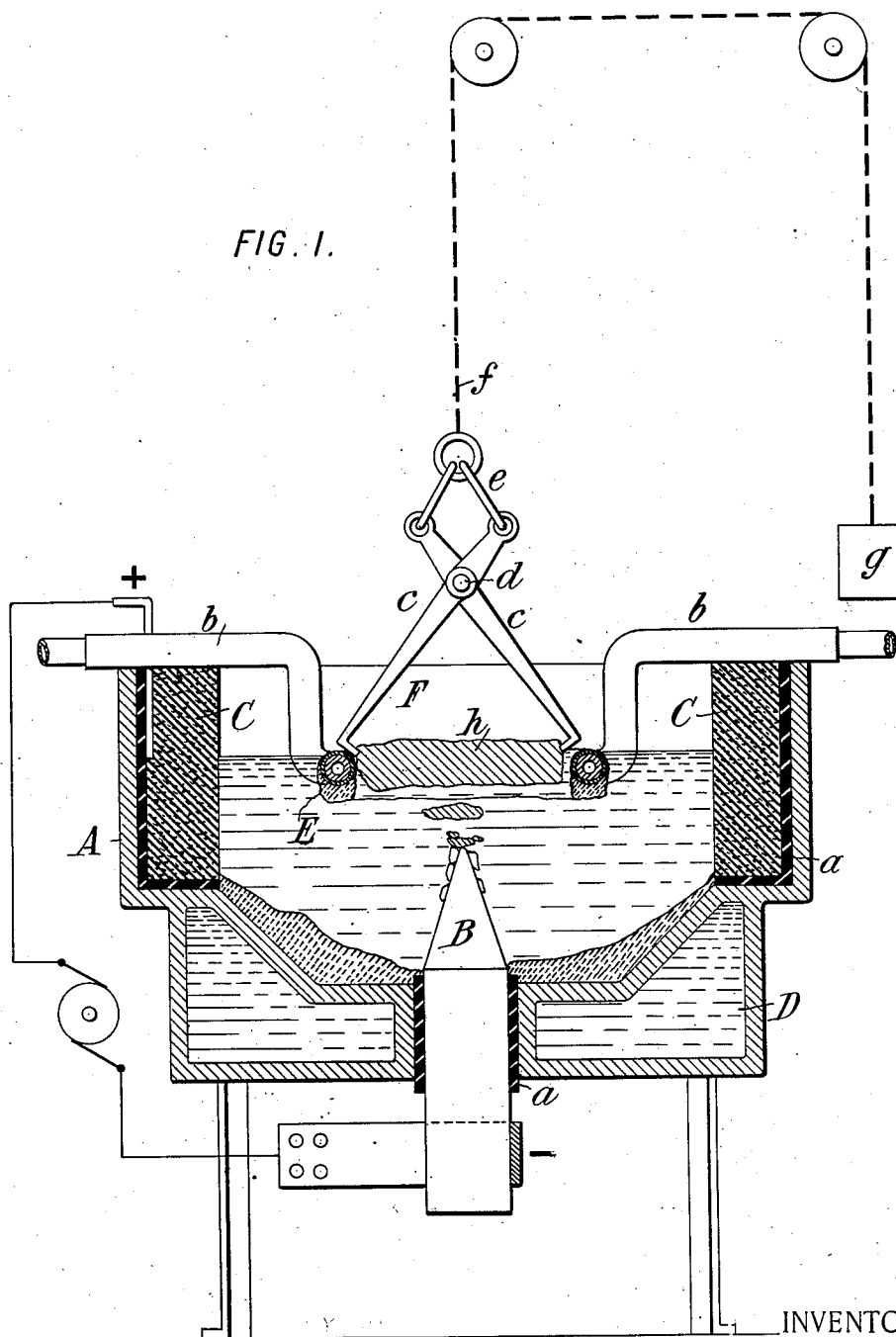
PATENTED MAR. 3, 1908.

G. O. SEWARD & F. VON KÜGELGEN.
PRODUCING METALS BY ELECTROLYSIS.

APPLICATION FILED APR. 24, 1906.

2 SHEETS—SHEET 1.

FIG. 1.



WITNESSES:

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Rene' Muine

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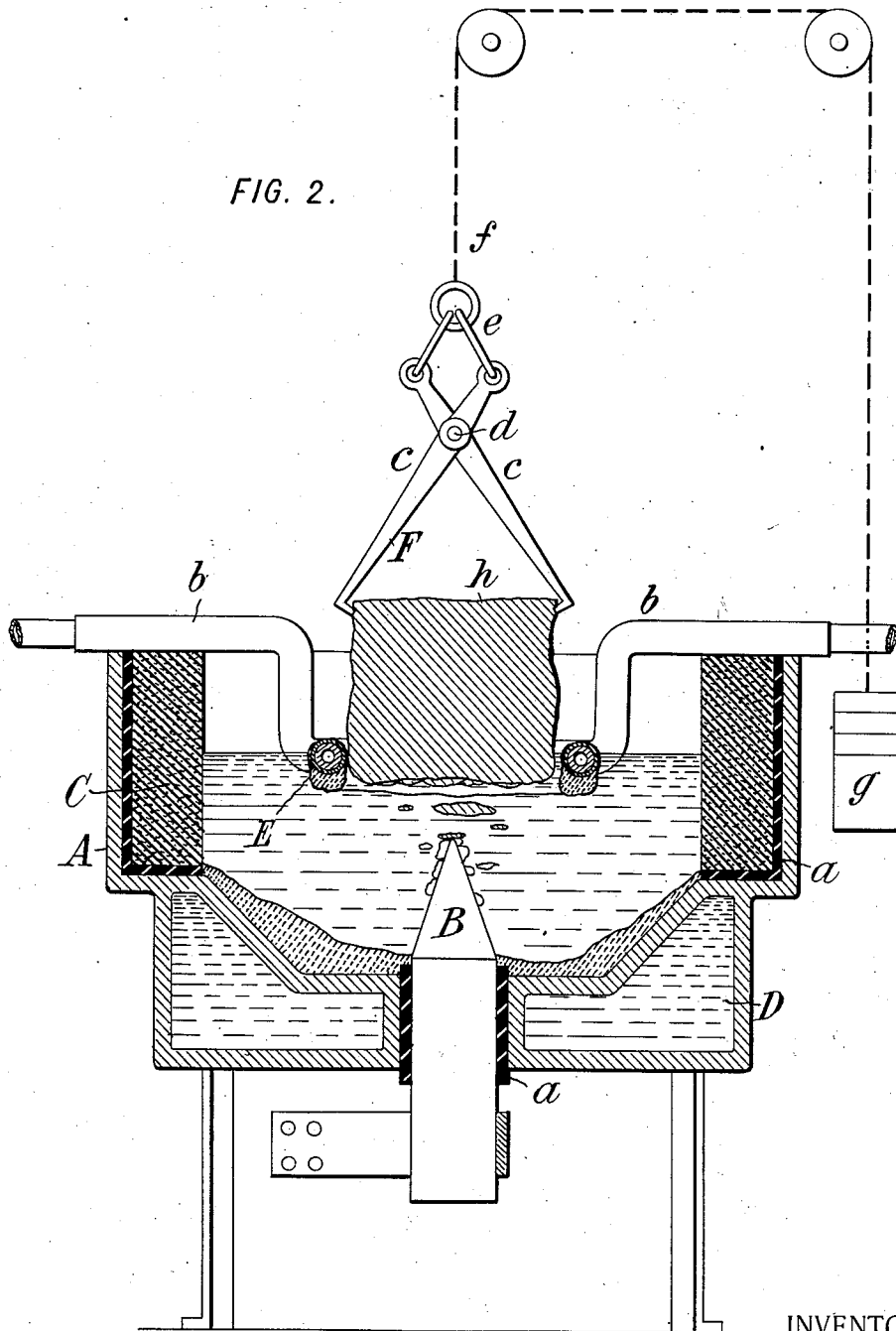
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INVENTORS:

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UNITED STATES PATENT OFFICE.

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

PRODUCING METALS BY ELECTROLYSIS.

No. 880,760.

Specification of Letters Patent.

Patented March 3, 1908.

Application filed April 24, 1906. Serial No. 313,387.

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 residing at Holcombs Rock, in the county of Bedford and State of Virginia, have jointly invented certain new and useful Improvements in Producing Metals by Electrolysis, of which the following is a specification.

This invention relates to the electrolytic production of those metals and alloys, of which calcium and its alloys are typical, which are lighter than their molten electrolytes, and whose melting points are either higher or not much lower than the melting points of their electrolytes. A difficulty hitherto encountered in the production of such metals is the tendency of many of them to burn when they come in contact with air at the temperature at which the electrolysis is conducted.

The present invention provides a method of producing and collecting such metals without loss, and which is carried out on any desired scale with ease and satisfactory freedom from minute attention to details.

According to our invention we electrolyze the molten electrolyte by means of a submerged cathode so that the light metal separates therefrom in a molten state and rises through the electrolyte, and we collect the metal under a movable protecting cover in contact with the electrolyte and preferably within a collecting ring. The protecting cover is best formed of a chilled mass of the light metal being produced, and is preferably lifted gradually from the electrolyte as it is built up or added to from beneath, so that a considerable mass of the desired metal in the form of a block or rod may be obtained.

Our invention may best be understood with reference to the accompanying drawings, which illustrate in vertical section a suitable electrolytic cell.

Figure 1 shows the apparatus at an early stage of the process. Fig. 2 shows the same at a later stage after a considerable mass of metal has accumulated.

The cell is formed by a vessel A, which may be of cast iron and which may preferably or advantageously be of circular form, having a cathode B projecting up centrally through its bottom, and an anode C of carbon

or graphite arranged annularly around its sides and preferably concentric with the cathode. The cathode and anode are separated from the iron vessel by layers *a a* of insulating material. The vessel is so adapted that when filled to a suitable level with the salt or salts forming the electrolyte, and receiving a sufficient current to maintain the latter molten, the bottom of the vessel will be protected by a chilled layer of the electrolyte. This is conveniently accomplished by forming it with a water-jacket D through which cold water may be circulated. The cathode, which may be made of iron or steel, and is preferably tapered or conical, terminates a suitable distance beneath the surface of the electrolyte. Above, and preferably concentric with it, is arranged a collecting ring or partition E provided with means for water-cooling it so as to chill upon its surface a sufficient layer of the electrolyte to protect it.

b b are the pipes for conducting the water to and from the tubular ring. The function of this ring is to confine the separated metal rising from the cathode and isolate it from the gases separated at the anode.

F is a lifting device, which may consist as shown of a pair of tongs *c c* jointed at *d* and connected by shackles *e* to a suspension cord or chain *f* which may be carried over pulleys to a counterweight *g*; or any other suitable construction of grappling device may be substituted.

In practicing our invention, the electrolytic vessel is kept full of a suitable electrolyte which is maintained in a molten state and electrolyzed by the current passing from the anode to the submerged cathode. The metal is separated in a molten state, and rises from the cathode to the top of the electrolyte, where it accumulates until the collecting ring is full of a layer of metal, the upper surface of which is chilled to a solid condition by the cooling action of the air, and the lower surface of which is soft or molten enough to cohere with the globules of metal constantly rising from the cathode. The temperature of the electrolyte is kept low enough to permit this cooling of the upper surface of the metal, so that the latter forms a plate or cover over the electrolyte and within the collecting ring. When a sufficiently thick layer of metal has formed on the surface of the

electrolyte it is either removed therefrom, or it is gradually withdrawn upwardly as it increases in depth, thus forming a rod or block of metal of any desired length. For thus
5 lifting it, it is sufficient to engage with it the tongs of the lifting device F and to elevate these tongs in any suitable manner, as by adding additional weights to the counterweight *g*, so as to partly counterbalance not only the
10 tongs but the weight of the mass *h* of produced metal, so as to lift the latter partly but not wholly out of the electrolyte. As the mass of metal is added to at the bottom, it may be gradually lifted, as, for example, by continu-
15 ally adding more weight to the counterweight. Fig. 2 shows the produced metal *h* extended to a considerable thickness vertically, its top part having been lifted to a proportionate height.

20 If desired, a cover of the same metal as is produced, or of another metal, may be used to fill the collecting ring at the beginning of the operation, but this is not essential, as it is possible to so regulate the temperature of
25 the electrolyte and so conduct the process that the accumulation of metal rising from the cathode forms its own cover. This is done in the following manner:— As the globules of metal rise to the top they are watched
30 carefully and prevented from burning by repeatedly immersing them in the electrolyte until a sufficient mass has accumulated to form a cover, the upper surface of which has
35 been so far reduced in temperature as not to burn in the air. This cover is quickly formed by the cohesion of the globules of metal as they rise from the cathode. It is even possible to dispense with a collecting ring, by
40 using at the start a cover plate which holds the globules of metal as they rise and prevents them from floating to the anode, but it is preferable to use a collecting ring, to facilitate the isolation and collection of the anode
45 gases, if this be desirable.

50 The shape and arrangement of the apparatus may, of course, be readily varied by one skilled in the art without departure from the invention. We do not limit ourselves to the use of a circular or concentric cell, although
55 this is preferable in order to form a symmetrical mass of the produced metal.

Our invention is applicable generally to the production of the earth-alkali metals, and particularly to calcium and magnesium. It
60 is also applicable to the production of such alloys of these metals as are sufficiently light to float to the surface of the electrolyte.

Our invention is not applicable to metals, such as sodium, which cannot be cooled to or
65 near to a solid condition while still in contact with the electrolyte.

We claim as our invention the following defined improvements in the art of produc-

ing by electrolysis metals which are lighter than their fused electrolytes, namely:— 65

1. In the electrolysis of fused electrolytes, causing the metal to separate in a molten state at a submerged cathode, rise through the electrolyte, and collect and solidify under a movable protective cover in contact with
70 the electrolyte.

2. In the electrolysis of fused electrolytes, causing the metal to separate in a molten state at a submerged cathode, rise through the electrolyte, and accumulate within a collecting ring and adhere to and solidify under a protective cover in contact with the electro-
75 lyte.

3. In the electrolysis of fused electrolytes, causing the metal to separate in a molten
80 state at a submerged cathode, rise through the electrolyte, and accumulate, cohere and solidify at the top to form a protective cover, the upper surface of which is chilled by cooling, while the under surface remains suffi-
85 ciently soft for the rising globules of metal to cohere therewith.

4. In the electrolysis of fused electrolytes, causing the metal to separate in a molten state at a submerged cathode, rise through
90 the electrolyte, and accumulate and solidify at the top within a collecting ring to form a protective cover, the upper surface of which is chilled by cooling, while the lower surface remains sufficiently soft for the rising glob-
95 ules of metal to cohere therewith.

5. In the electrolysis of fused electrolytes, causing the metal to separate in a molten state at a submerged cathode, rise through the electrolyte, and accumulate and solidify
100 under a protective mass of the same metal, chilling the upper portion of the mass, and withdrawing the same gradually from the electrolyte so as to form rods or blocks of the desired metal. 105

6. In the electrolysis of fused electrolytes, electrolytically separating an earth-alkali metal from a suitable electrolyte at a submerged cathode, and collecting the metal or alloy by causing it to solidify under a mov-
110 able protective cover in contact with the electrolyte.

7. In the electrolysis of fused electrolytes, electrolytically separating calcium from a suitable electrolyte at a submerged cathode,
115 and collecting the metal or alloy by causing it to solidify under a movable protective cover in contact with the electrolyte.

In witness whereof, we have hereunto signed our names in the presence of two sub-
120 scribing witnesses.

GEORGE O. SEWARD.

FRANZ VON KÜGELGEN.

Witnesses:

J. H. WEBB,

P. O. HARDING.