G. O. SEWARD & F. VON KÜGELGEN.

CATHODE FOR ELECTROLYTIC FURNACES.

APPLICATION FILED OCT. 10, 1910. RENEWED SEPT. 10, 1913.

1,092,178. **Patented Apr. 7, 1914.**

Fig. 1.

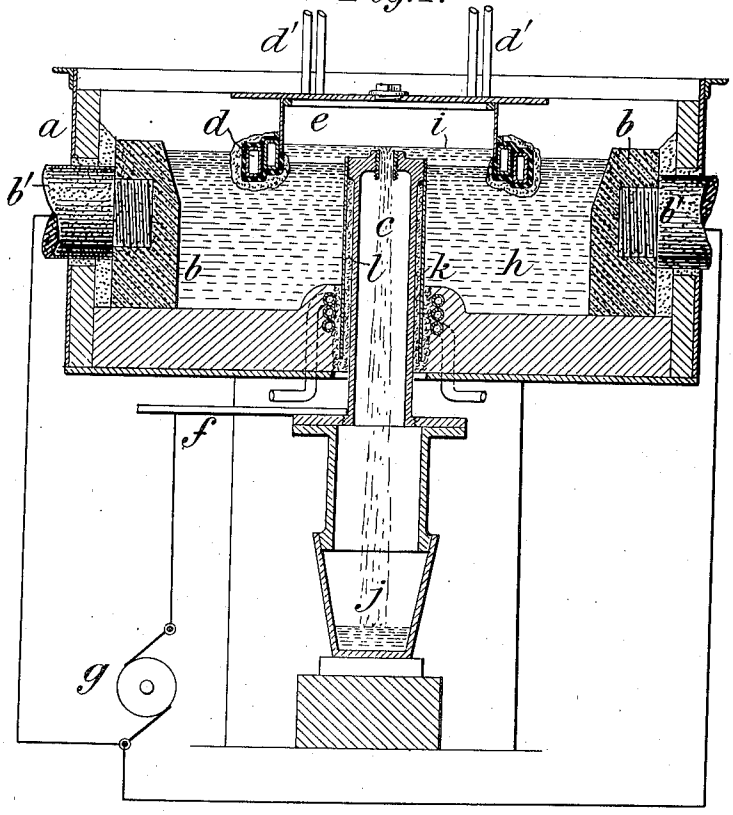


Fig. 2.

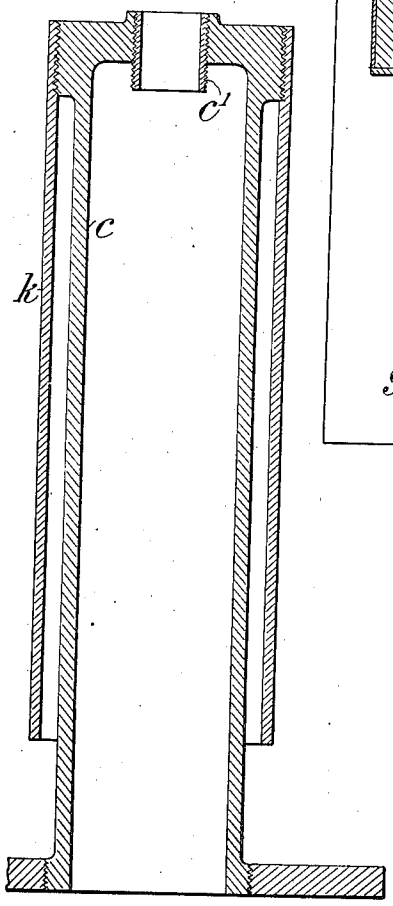
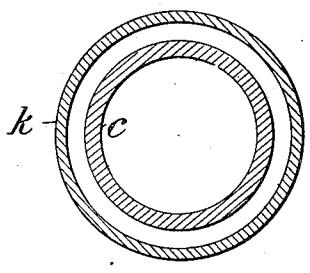


Fig. 3.



WITNESSES:

Fred White

René Bruine

INVENTORS:

George O. Seward and

Franz Von Kügelgen

By Attorneys,

Fraser, Dunlop & Myers

A. G. Fraser

UNITED STATES PATENT OFFICE.

GEORGE O. SEWARD, OF EAST ORANGE, NEW JERSEY, AND FRANZ VON KÜGELGEN, OF HOLCOMBS ROCK, VIRGINIA, ASSIGNORS TO VIRGINIA LABORATORY COMPANY, OF NEW YORK, N. Y., A CORPORATION OF NEW YORK.

CATHODE FOR ELECTROLYTIC FURNACES.

1,092,178. Specification of Letters Patent. Patented Apr. 7, 1914.

Application filed October 10, 1910, Serial No. 586,132. Renewed September 10, 1913. Serial No. 789,171.

To all whom it may concern:

Be it known that we, GEORGE O. SEWARD, a citizen of the United States, residing at East Orange, in the county of Essex and State of New Jersey, and FRANZ VON KÜGELGEN, a subject of the German Emperor, residing at Holcombs Rock, in the county of Bedford and State of Virginia, have jointly invented certain new and useful Improvements in Cathodes for Electrolytic Furnaces, of which the following is a specification.

This invention relates to electrolytic furnaces such as are used for the production of metals lighter than their fused salts which serve as the electrolyte, so that the produced metal rises from the cathode and floats upon the surface of the electrolyte. Such furnaces are best constructed with a central cathode projecting upwardly from beneath, surrounded by an outer anode or series of anodes arranged continuously or intermittently around the cathode, and with an intervening non-conducting partition or curtain projecting from above down into the electrolyte so as to partially separate the anolyte from the catholyte and form a cathode chamber within which the sodium or other light metal collects. In the operation of such furnaces currents of very large volume or amperage are employed; and these currents flowing from the anode through the electrolyte to the cathode, dip beneath the annular partition or curtain and partly ascend into the floating bath of light metal (which forms electrically a part of the cathode) and flow thence in converging lines through this metal to the cathode, and thence downwardly through the cathode to the negative terminal. These currents are found in practice to have certain disadvantageous magnetic reactions which it is desirable to avoid.

The present invention practically obviates the disadvantage of these conditions by the construction of the cathode with an outer metallic envelop or skirt, separated from it except at its upper part and projecting downwardly, whereby that portion of the current which passes directly through the electrolyte to the cathode (instead of upwardly to the floating light metal) enters such outer skirt, and by ascending therethrough parallels the descending current in the inner cathode, and thereby sufficiently neutralizes the negative effect of the downward current flow therein to effectively obviate the disadvantages stated.

The invention will be made more clear by reference to the accompanying drawings, wherein—

Figure 1 is a vertical mid-section of an electrolytic furnace to which our invention is applied; Fig. 2 is a vertical mid-section on a larger scale of the cathode; Fig. 3 is a transverse section thereof.

In the form of furnace shown in Fig. 1, *a* is a metallic containing shell, *b* is the anode of carbon, *c* the cathode of iron, and *d* the partition or curtain partially separating the anode and cathode, and which forms within it the cathode chamber *e*. The current from the dynamo or other generator *g* is conducted through carbon rods *b'* to the anode, and from the cathode terminal bar *f* to the negative pole of the generator. The electrolyte *h* is the fused salt of the metal to be produced, for example sodium chlorid if sodium is to be separated, and *i* is the pool of sodium or other light metal floating upon the electrolyte within the cathode chamber *e*. The partition *d* is of tubular metal through which a cold fluid circulates through pipe *d'* to chill it and congeal upon it an insulating layer or crust of the salt constituting the electrolyte. In operation, the metal which is separated at the surface of the cathode rises through the electrolyte and collects within the partition *d*, forming a pool *i* of metal, which gradually overflows into the hollow cathode, being guided therein by a central tube or annular lip *c'*, and is caught in a vessel *j* beneath.

Heretofore the cathode has been a simple tubular iron casting projecting up through the bottom of the furnace and up through the electrolyte to within the partition *d*. According to the present invention there is added to the cathode an outer tubular envelop or skirt *k* which is metallically united to it at its upper part, as for example by being screwthreaded thereto, and is separated and insulated from the main cathode beneath, all as clearly shown in Figs. 1 and 2. The space between the skirt and main cathode may advantageously be filled with an insulating packing *l*, preferably of asbestos.

With a cathode as heretofore constructed

the current flow in the cathode is solely downward, the converging lines of current flow through the electrolyte upon entering the cathode being immediately turned downward as part of the downward flow therein. When a pool of sodium *i* is maintained upon the electrolyte it forms an extension of the cathode, so that a portion of the current flowing through the electrolyte ascends into this pool and the current flow in the latter is convergent to the iron cathode. It is found that the magnetic reaction occurring between these currents, has the effect (which is particularly noticeable when very large currents are used) of lifting the catholyte and of partially repelling it from the iron cathode, so that the pool of sodium is liable to be drained off through the discharge passage within the cathode. This result is disadvantageous since it is desirable to maintain the sodium pool as an extension of the iron cathode, and to maintain the current flow principally in the upper part of the electrolyte.

The present invention by introducing an auxiliary cathode in the form of a skirt or shell surrounding the main cathode and conductively united to it only at the top, has the effect of collecting from the electrolyte all the lines of current flow which do not curve upwardly and into the sodium layer *i*, and causes the combined electric currents thereby resulting to ascend through this skirt to nearly the top of the cathode, so that this ascending current by oppositely paralleling the descending current in the main cathode, so far neutralizes the latter as to nearly eliminate the effects above referred to, with the practical result that these effects are so minimized that they cease to be apparent in the operation of the furnace, and are no longer a source of annoyance. Another desirable effect realized by this construction of cathode is the comparative concentration of the current toward the top of the cathode. The improvement has approximately the same effect as if the current were to leave the electrolyte near the top thereof, as for example by a cathode carried out through the top of the furnace. It is necessary to these results to keep the skirt insulated from the main cathode, except at the top.

The present invention is not necessarily limited to the precise construction and arrangement of electrolytic furnace or cell shown. The concentric arrangement of central cathode, surrounding partition and outer anode is preferable, but may be departed from. The distinguishing feature of our invention is the addition to the ordinary or main cathode, of the downward projection therefrom which we have called the skirt, and which separates it from the electrolyte and is electrically connected to the main cathode at its upper part only.

We claim as our invention:—

1. An electrolytic furnace for the separation of metals from their fused salts comprising an anode and a cathode, the cathode having a downwardly-projecting portion separating it from the electrolyte and in conducting contact with it at its upper portion only.

2. An electrolytic furnace for the separation of metals lighter than their fused salts comprising an anode, a cathode, and an intervening insulating partition within which the separated metal is confined and floats on the electrolyte in conducting contact with the cathode, the cathode having a downwardly-projecting portion separating it from the electrolyte and in conducting contact with it at its upper portion only.

3. An electrolytic furnace for the separation of metals lighter than their fused salts comprising a central cathode, an outer anode, and an annular insulating partition between them within which the separated metal is confined and floats on the electrolyte in conducting contact with the cathode, the cathode having a downwardly projecting portion surrounding it and separating it from the electrolyte and in conducting contact with it at its upper portion only.

4. A cathode for electrolysis comprising parallel portions in which the electric flow is opposite, whereby to minimize magnetic or inductive effects.

5. A cathode for electrolysis comprising an inner portion and a surrounding skirt separated therefrom except at an end portion and connected to cause the electric flow in the inner and outer portions to take place in opposite directions.

6. A cathode comprising outer and inner vertical tubular portions connected only at the upper part, the outer one in contact with the electrolyte serving as the active cathode, and the inner one serving as the electric conductor and as an overflow pipe for the separated product.

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

GEORGE O. SEWARD.
FRANZ VON KÜGELGEN.

Witnesses:
WILLIAM F. MARTINEZ,
T. F. WALLACE.