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A. CREMER

APPARATUS FOR THE ELECTROLYSIS OF METALS

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Fig. 1.

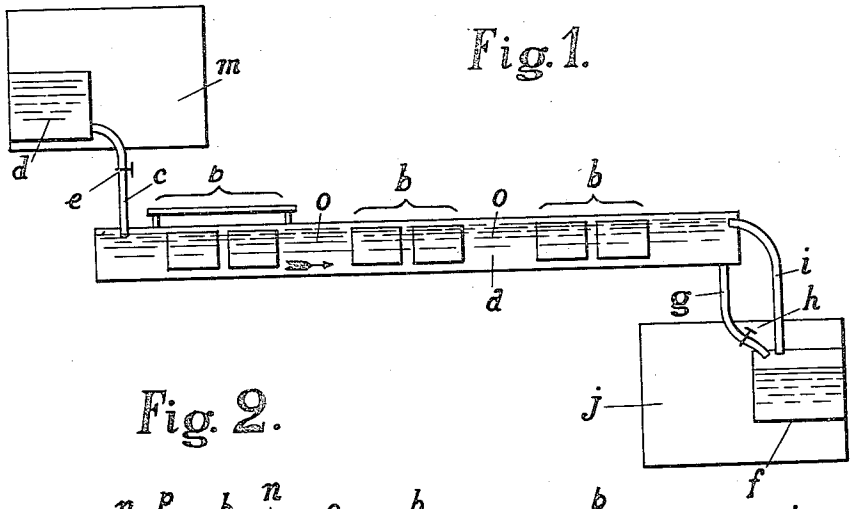
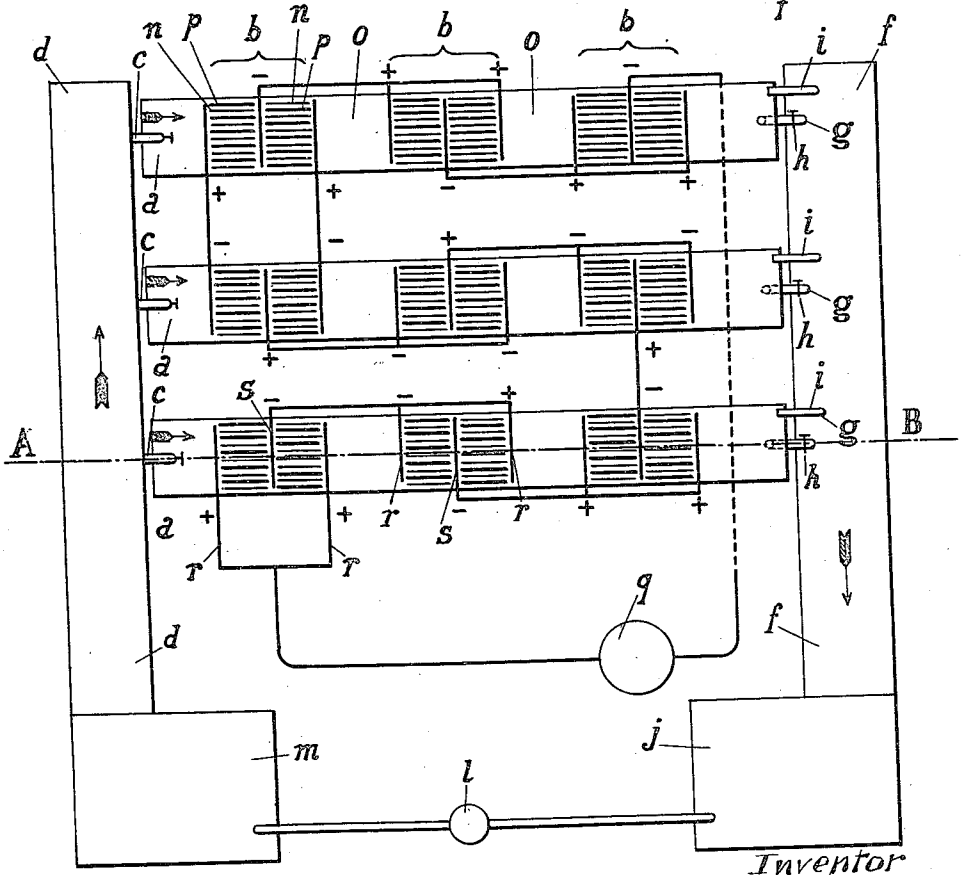


Fig. 2.



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UNITED STATES PATENT OFFICE.

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APPARATUS FOR THE ELECTROLYSIS OF METALS.

Application filed October 7, 1922. Serial No. 593,137.

To all whom it may concern:

Be it known that I, ALFRED CRÉMER, subject of the King of the Belgians, residing at Verviers, Belgium, have invented certain new and useful Improvements in Apparatus for the Electrolysis of Metals, of which the following is a specification.

Electrolytic operations for separating a metallic element from a solution in which this element is dissolved are generally carried out in tanks each of which contains a certain number of electrodes suspended in the solution. For the purpose of renewing the solution and improving the yield, a continuous circulation of the electrolyte is set up between the different successive tanks. To this end, the solution which has done work in one tank is drawn off by a siphon which delivers it into the next tank.

The efficiency of installations of this kind is limited by the density of the current. In fact the weight of metal precipitated on the cathodes is proportional to the surface thereof and to the density of the current used. It is therefore possible, theoretically at any rate, to consider that the output of an electrolytic apparatus is substantially proportional to the density of the current per unit of surface of the cathode.

In practice the cost of the power and the quality of the metal precipitated tend to limit this density. As regards the cost of the motive power it is known that when the density of the current increases, the expense of the motive power increases likewise. A certain limit for the density of the current cannot therefore be exceeded without excessive expense for motive power being incurred. Furthermore, if the density of the current increases, the phenomena of polarization inherent in all electrolysis also increase in intensity, the conditions favourable to a good electrolytic separation disappear and the quality of the metal deteriorates.

The object of the present invention is to permit of the use of ordinary high densities where the motive power is cheap and in particular to utilize for example hydraulic power at night, which is not otherwise required. It will be understood that if a cheap source of motive power is available the density of the current can be raised without excessively increasing the cost of the motive power and the benefit can also be reaped of a considerable reduction in the surface of the installations necessary to the same production.

To be able to use these high densities without impairing the quality of the metal it is necessary to modify the old electrolytic apparatus so as efficaciously to combat the phenomena of polarization. High densities have already been used with rotating cathodes but this has proved to be a costly solution of the problem.

The characteristic feature of the present invention is to keep the electrodes stationary and to impart a rapid movement to the electrolyte parallel with the surface of the electrodes, and this is obtained by combining the tanks in series so as to form a continuous channel, in which are placed in succession groups of electrodes arranged parallel with the axis of the channel and separated from each other by suitable volumes of electrolyte. It will be understood that by this arrangement a much more rapid circulation can be obtained than with the system of separate tanks, in which it is necessary to reckon also with the possible eddies created by the suction of the siphon in the regions near the bottom.

The invention therefore permits of the use of high densities in cases where motive power is cheap. In the special case of the use of discontinuous forces, the channels are capable of being emptied rapidly during the interruption of the current for the purpose of withdrawing the electrodes from the chemical action of the bath if necessary. In spite of the diminution of the working hours in discontinuous working the efficiency of working is capable of exceeding the efficiency afforded by the old methods owing to the enormous reduction of the capital sunk therein.

In the accompanying drawing, which represents diagrammatically and by way of example an installation for the electrolytic refining of copper,

Figure 1 is a section on the line A—B of Figure 2; and

Figure 2 is a plan of the installation.

The installation represented comprises three long tanks or channels *a*, each containing three groups *b* of electrodes and each corresponding to three ordinary tanks. The channels *a* are supplied in parallel at one of their ends by means of pipes *c* leading from a distributing channel *d* and provided

with cocks *e*. At the other end of the channels *a* is a collecting channel *f* into which the channels *a* deliver the electrolyte by pipes *g* provided with cocks *h* which allow the rate of flow to be regulated. Each channel is likewise provided with an overflow pipe *i*.

In the example represented the electrolyte is kept in continuous circulation and the circuit formed by the channels *d*, *a* and *f* is completed by a collecting reservoir *j*, a pipe *k*, in which is interposed a pump *l*, and the feed reservoir *m*. In the collecting reservoir *j* the electrolyte may be subjected to filtration before it returns to the reservoir *m*.

In the channels *a* are shown groups *b* each composed of two series of electrodes *n*, *p*. These electrodes are placed parallel with the length of the channels *a* and consequently with the direction of the electrolyte therein. The negative electrodes *n* and the positive electrodes *p* alternate from one series to the other as shown in Figure 2. Each group *b* of electrodes constitutes the elements of an ordinary tank, all the electrodes of the same group being placed in shunt with relation to the supply conductors *r* and the return conductors *s* for the electric current. These conductors are connected together in series and are supplied for example by a source of electrical energy *q*. Each group of electrodes is separated from the neighbouring groups by spaces *o* filled with electrolyte.

The rapid circulation of the electrolyte and the alternation of the electrodes is favorable to the homogeneity of the solution. This uniformity in the composition of the solution is easily obtained, not only because the solution returns frequently to the reservoirs where the necessary corrections are made but also in consequence of the interruptions of the work in the case of discontinuous working. It is also advantageous, with respect to the homogeneity of the solution, to give the channels a comparatively small depth, as in the example illustrated, wherein the depth of the channels is about one half of their width.

It will be understood that various modifications may be made in the arrangements shown without departing from the scope of the invention.

I claim—

1. In apparatus for the electrolysis of metals, a continuous channel, a plurality of groups of co-operating electrodes arranged in succession within said channel, said groups being substantially isolated from each other within said channel by spaces adapted to be filled with electrolyte.

2. In apparatus for the electrolysis of metals, a continuous channel, a plurality of groups of co-operating electrodes in said channel, said electrodes being arranged parallel to the longitudinal axis of said channel, said groups being substantially isolated from each other within said channel by spaces adapted to be filled with electrolyte.

3. In apparatus for the electrolysis of metals, a continuous channel, a plurality of groups of co-operating electrodes arranged in succession in said channel, each group being composed of series of electrodes, the electrodes of opposite polarity alternating from one series to the next, said groups being substantially isolated from each other within said channel by spaces adapted to be filled with electrolyte.

4. In apparatus for the electrolysis of metals, a continuous channel, a plurality of groups of co-operating electrodes arranged in succession in said channel, said groups being substantially isolated from each other within said channel by spaces adapted to be filled with electrolyte, a distributing channel adapted to deliver electrolyte to one end of said continuous channel, a collecting channel adapted to receive electrolyte from the other end of said continuous channel, and means for transferring electrolyte from said collecting channel to said distributing channel.

In testimony whereof I have affixed my signature in presence of two witnesses.

ALFRED CRÉMER.

Witnesses:
H. T. E. KIRKPATRICK,
H. W. PLUCKER.