Aug. 5, 1958 P. MOREL 2,846,388

CONSTRUCTION OF THE LOWER PART OF THE CRUCIBLE OF IGNEOUS ELECTROLYSIS CELLS

Filed April 23, 1956 2 Sheets-Sheet 1

Fig.1

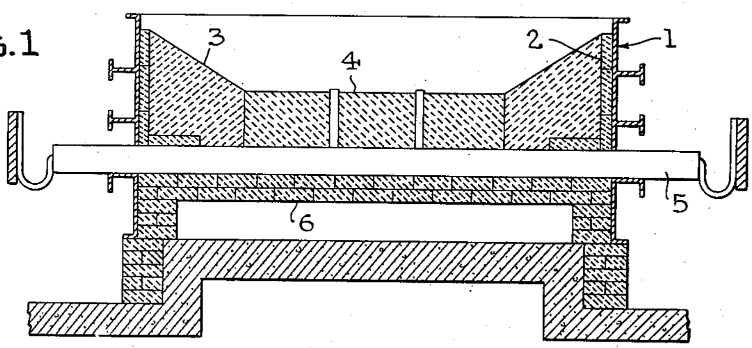


Fig.2

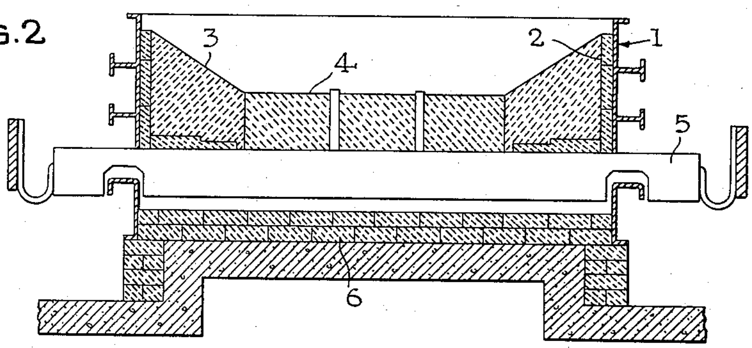


Fig.3

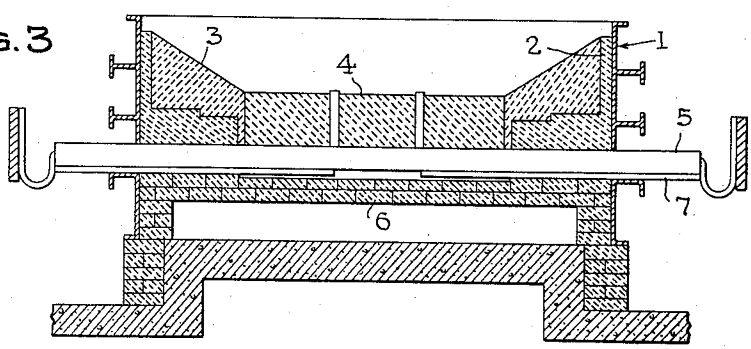
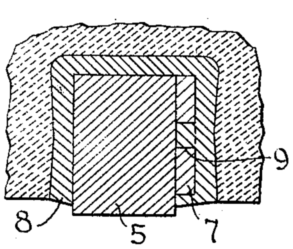


Fig.4



INVENTOR

Paul Morel

BY Raphael Semmes

ATTORNEY

Aug. 5, 1958 P. MOREL 2,846,388

CONSTRUCTION OF THE LOWER PART OF THE CRUCIBLE OF IGNEOUS ELECTROLYSIS CELLS

Filed April 23, 1956 2 Sheets-Sheet 2

Fig. 5

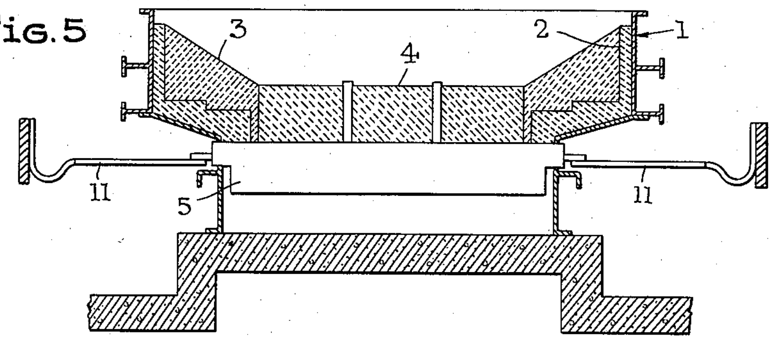


Fig. 6

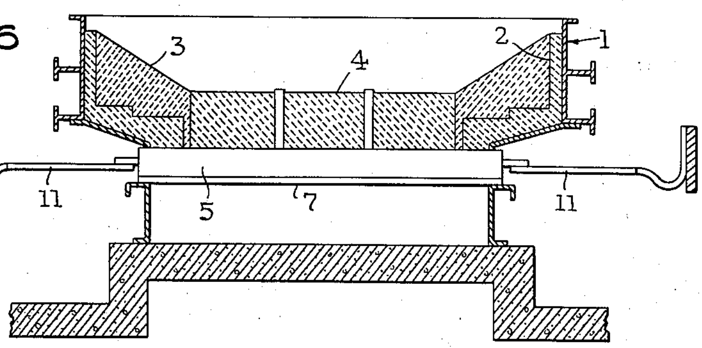


Fig. 7

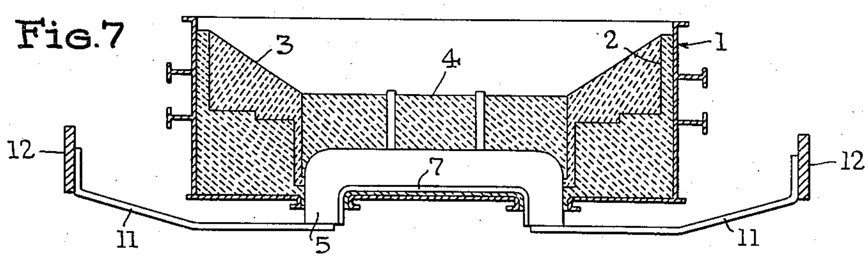
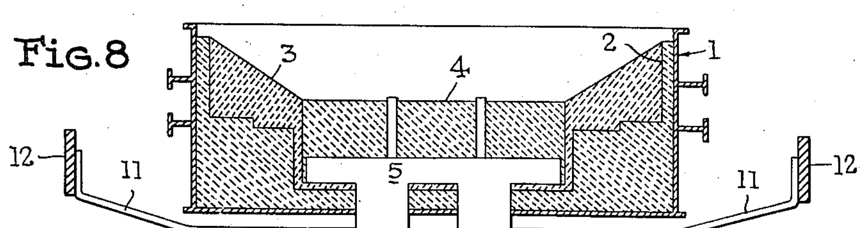


Fig. 8



INVENTOR

Paul Morel

BY

ATTORNEY

United States Patent Office

2,846,388

Patented Aug. 5, 1958

1

2,846,388

CONSTRUCTION OF THE LOWER PART OF THE CRUCIBLE OF IGNEOUS ELECTROLYSIS CELLS

Paul Morel, Hermillon, France, assignor to Pechiney Compagnie de Produits Chimiques et Electrometallurgiques, Paris, France, a corporation of France

Application April 23, 1956, Serial No. 579,828

Claims priority, application France April 30, 1955

4 Claims. (Cl. 204—243)

Cells for use in igneous electrolysis and, more particularly, those intended for the manufacture of aluminum, operate at low voltages, at times of the order of 4 to 4.5 volts. Accordingly, it is important to reduce as far as possible the various voltage drops which are useless in the electrolysis. In French Patent No. 953,361, there are already described methods for insuring the electrical connection between the carbon blocks forming the bottom of the crucible of the electrolysis cell and the metallic bars for the current inlet or outlet (depending whether the operation relates to the production of aluminum by electrolysis, or the refining of this metal). In accordance with those methods, the steel bars—generally of rectangular cross-section—are sealed in grooves provided in the carbon blocks by means of cast-iron of well defined quality, whereby there is obtained as low a voltage drop as possible in the bottom of the cell.

These methods are entirely satisfactory; however, present developments in the art have been in the direction of providing all-around the circumference of the cell crucible sloping banks of solidified cryolite which reduce the surface of the crucible bottom to a size which is approximately equal to the surface of the anode assembly. In this manner, it is possible to decrease the magnitude of level variation and movement of liquid aluminum in the bottom of the cell crucible, and it is possible to obtain thereby very high electrolysis yields which attain, and sometimes even exceed, 90%.

On the other hand, inasmuch as the active surface of the crucible bottom has been reduced by the presence of these sloping banks, the voltage drop increases and frequently attains 0.40 volt. It is accordingly quite important to reduce this voltage drop without modifying the new methods of operating electrolysis cells.

The present invention, which is based on applicant's investigations, solves this problem. It is based on the fact that the largest part of the voltage drop in the crucible bottom is due to the electric resistance of the steel bars which insure the connection between the carbon blocks and the external conductors. Hence, the invention comprises means for increasing the electric conductivity of this connection, which may be realized by several embodiments of the invention.

According to a first embodiment of the invention, the cross-section provided for the passage of the current is increased by adopting thicker steel bars, or by welding to at least one surface of the steel bar a copper bar. This embodiment is carried out without changing the total length of the bars.

The copper bar can be welded onto that face of the steel bar which is not in contact with the cast-iron seal. It can equally be welded to a lateral face of the steel bar, the copper bar being then partially immersed in the liquid cast-iron at the time when the steel bar is sealed in the grooves provided in the carbon blocks. The current proceeding from the blocks can then pass directly into the copper.

2

According to a second embodiment of the invention, the length of the steel bars is reduced, this being made possible by a corresponding reduction in the width of the lower part of the cell. The length of steel thus eliminated can be replaced by aluminum conductors the electric conductivity of which is better. Steel bars having a large cross-section can be used or else, they can be reinforced by a copper bar.

According to a third embodiment of the invention, the width of the lower portion of the cell is not modified, but the connecting bars extend through the bottom of the cell, either by bending them at right angles immediately opposite the external edge of the carbon blocks, or by giving them a convenient shape.

The annexed diagrammatic figures will give a better understanding of the invention. Of these,

Figure 1 represents a transverse vertical section of an electrolysis cell constructed according to the prior art; it is the purpose of the present invention to improve such construction;

Figures 2 and 3 represent transverse vertical sections of two variants of the first embodiment of the invention;

Figure 4 represents to an enlarged scale a partial cross-section, through a vertical plane perpendicular to that of Figure 3, of a detail;

Figures 5 and 6 represent transverse vertical sections of two variants of the second embodiment of the invention;

Figures 7 and 8 represent transverse vertical sections of two variants of the third embodiment of the invention.

The same reference numerals designate the same or corresponding parts in the several figures.

1 designates the metallic casing which surrounds the cell, **2** an insulating layer, **3** the carbon walls of the crucible, **4** the carbon blocks forming the bottom of the cell and comprising at their lower part a groove in which the steel bar **5** is sealed in by cast-iron. **6** designates a foundation formed of refractory insulating bricks on which the crucible rests.

As will be seen from Figure 1, the steel bar **5** does not extend at the bottom beyond the lower part of the carbon blocks and, as a result, its dimensions are limited. When the cell is operated at relatively low temperatures, such as 930–950° C., and with lateral sloping banks of solid cryolite, the potential drop in the bottom of the electrolysis cell illustrated in Figure 1 amounts to 0.40 volt.

In Figure 2, the bars **5** have a cross-section triple that of those shown in Figure 1 and, as a result, the potential drop in the bottom is reduced to 0.30 volt. However, in this arrangement the bars penetrate deeply into the foundation **6** which complicates the construction; moreover, it is necessary that the bars be deeply notched at the places where they pass into the casing **1** in order to avoid excessive weakening of the latter's strength.

To avoid these drawbacks, the arrangement illustrated in Figure 3 can be adopted. According to this variant of the invention, the bar **5** retains its original dimension as in Figure 1, but there is welded to its lower part a copper strip **7**, either on the entire length of the steel bar, or with an interruption underneath the central block, as shown in Figure 3. A copper strip having a cross-section of 100 mm. x 20 mm. is the equivalent (in conductivity), at the operating temperature, of steel bars 200 mm. x 120 mm., that is, sections 12 times larger. The potential drop is the same as in Figure 2, namely 0.30.

Figure 4 represents to an enlarged scale a detail of a carbon block adjacent a seal. As will be observed, the copper bar **7**, welded to a lateral face of the steel bar **5**, is surrounded by the cast-iron seal **8**. The copper bar can be perforated, for example, at **9**, in order to insure improved connection between the cast-iron and the copper. By this means, there can be obtained a gain of about 0.03 volt as compared with the arrangement illustrated in Figure 3. That is, the potential drop is now 0.027.

Since for equal conductivity aluminum is a cheaper conductor than steel, provision is made according to the second embodiment of the invention for a shortening in the length of the steel bars (Figure 5) and for the replacement of the eliminated ends by aluminum bars **11**. It is then necessary to decrease the width of the lower portion of the casing because aluminum cannot withstand the temperatures prevailing therein and, hence, must be disposed externally thereof.

Figure 5 represents such an arrangement using steel bars of large cross-section extending outside the bottom of the groove provided in the carbon blocks.

Figure 6 represents the same casing narrowed down at its lower part, but having steel bars which do not extend outside the groove in the carbon blocks, the said bars being reinforced by a welded copper plate **7**.

By adopting the arrangement represented in Figures 5 and 6, there is obtained a voltage drop of 0.25 volt in the bottom of the cell.

In the third embodiment of the invention, contraction of the lower portion of the casing is avoided while shortening, nevertheless, the steel bars. This result is obtained by passing out the end of the bars through the bottom of the cell.

In the arrangement of Figure 7, the bars are bent at right angles opposite the blocks and the aluminum conductors **11** are then longer than in Figures 5 and 6. Moreover, it is possible to dispose underneath the cells the conductors **12** which collect the current from the steel bars.

The bent bars **5** can be strengthened by means of a copper strip **7**. It is possible to obtain thereby a potential drop somewhat lower than 0.25, for example, a drop of 0.24.

In Figure 8, the steel bar **5** has exactly the same length as the assembly of the bottom blocks; the current leaves through vertical steel bars. The assembly has approximately the shape of the Greek letter "pi." This shape can be obtained either by forging or by welding. The potential drop in the bottom can readily amount to 0.24 volt.

It is evident that by welding a thicker sheet of copper onto the steel, it is posible to reduce still further the potential drop in the bottom of the cell, indeed, in all three embodiments above described. However, a lower potential drop necessitates increased thermal insulation,

hence, increased installation costs. The most favorable cross-sections and lengths of the steel, copper and aluminum conductors depend on the price of these raw materials and the cost of the energy in the particular region. A person skilled in the art can determine these in each particular case without departing from the scope of the present invention.

I claim:

1. A cell for use in igneous electrolysis comprising, in combination: a lower portion provided with carbon blocks; grooves in said blocks; current conducting ferrous bars positioned in said grooves in contact with said blocks, said bars having a length significantly shorter than the width of the cell at its upper portion; sloping banks of solidified matter disposed all around the inner circumference of the cell; whereby the active surface of the cell bottom is decreased and the voltage drop in the bottom of the cell is detrimentally increased; and conductors having an electrical conductivity higher than that of said bars extending from the ends of said bars and forming means of attachment to a source of current, whereby the potential drop in the bottom of the cell is advantageously decreased.

2. A cell according to claim 1 wherein the conducting bars are formed of steel, and the conductors of higher conductivity are formed of aluminum.

3. A cell for use in igneous electrolysis comprising, in combination: a lower portion of contracted width relative to the top portion of the cell; carbon blocks in said lower portion; grooves in said blocks; current conducting ferrous bars positioned in said grooves in contact with said blocks, said bars having a length substantially coextensive with said contracted width; sloping banks of solidified matter disposed all around the inner circumference of the cell; whereby the active surface of the cell bottom is decreased and the voltage drop in the bottom of the cell is detrimentally increased; and conductors having an electrical conductivity higher than that of said bars extending from the ends of said bars and forming means of attachment to a source of current, whereby the potential drop in the bottom of the cell is advantageously decreased.

4. A cell according to claim 3, wherein the conducting bars are formed of steel, and the conductors of higher conductivity are formed of aluminum.

References Cited in the file of this patent

UNITED STATES PATENTS

2,249,765	Hulse	July 22, 1941
2,593,751	Grolee	Apr. 22, 1952