Sept. 11, 1962 P. MOREL ETAL 3,053,748

NOVEL TYPE ELECTRODE FOR ELECTROLYTIC CELLS

Filed June 10, 1958

Fig.1

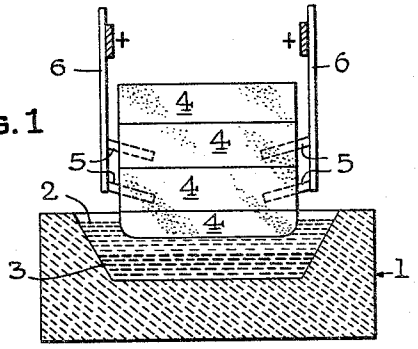


Fig.2

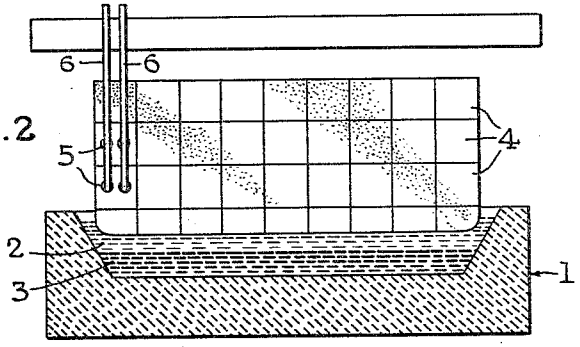


Fig.3

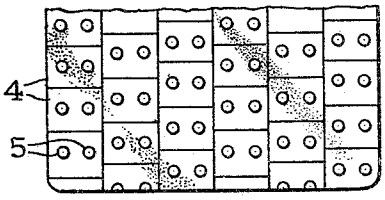


Fig.4

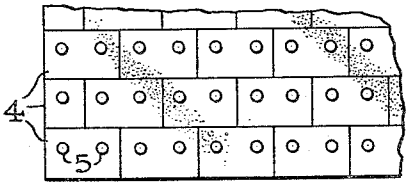


Fig.5

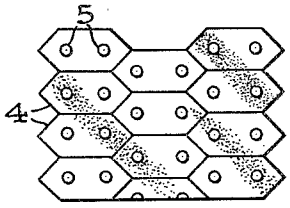
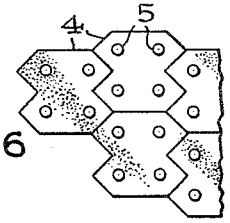


Fig.6



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NOVEL TYPE ELECTRODE FOR ELECTROLYTIC CELLS

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The present invention, which is the result of research by applicants, relates to a novel type of anode, for electrolysis cells, the method used in its manufacture and the method of using the same.

Electrolysis cells, especially those carrying heavy currents amounting to tens of thousands of amperes, such as those used in the production of aluminum, are provided with anodes of very pure carbon which are consumed during the electrolysis process. For many years, there have been used as anodes blocks of carbon agglomerated with a pitch binder and preliminarily baked at high temperatures in special furnaces. These anodes, which had rather restricted dimensions, had to be frequently replaced and could not be completely used up on account of the current inlets which were fixed thereto. Hence, it was necessary to reuse the unused portions which were always partly soiled (contaminated).

During the last thirty years there have been used in electrolysis cells employed in the production of aluminum continuous anodes of the Soderberg type which avoid the above named drawbacks. They are composed of a raw (unbaked) mixture of comminuted carbon and pitch which is poured into a metallic casing and are baked by the waste heat of the electrolysis cell itself, thereby enabling the elimination of the special baking furnaces.

However, in order to obtain Soderberg electrodes of good quality, it is necessary to use a relatively high percentage of pitch, of the order of 30%. The necessity of placing the paste in a metallic casing increases the construction costs of the cell. Moreover, when the current inlets are placed on the lateral faces (sides) of the anodes, the metallic casing is reenforced by a framework of steel shapes which must be removed when they near (arrive) in the proximity of the bath, and be again elevated to the upper part of the anode, all of which involves an arduous and costly operation.

It has recently been attempted to obtain continuous anodes by the use of preliminarily baked units, which are superposed and bound (stuck) to each other at their horizontal faces by the use of a special paste. In the case of high amperages, it is necessary to use several of such anodes leaving a space in between. As a result, it is not possible to obtain as easy a control of the electrolysis cell as in the case where it is provided with a single anode of the Soderberg type. In addition, the danger exists that the lateral faces of the anodes which are adjacent to each other may burn. Moreover, it is still necessary to retain the furnaces used for baking the anodes.

The present invention relates to a novel type of continuous anode for electrolysis cells which possesses the advantages of the known anodes, but avoids their disadvantages. The invention further comprehends the method of forming such anodes, as well as the manner of their use in carrying out igneous electrolysis.

The anodes according to the present invention are constituted of unbaked (raw) blocks which are piled up in such a fashion as to form a single anode, the proportion (percentage) of pitch being so chosen that the raw anode, which does not comprise a casing, is progressively baked without being deformed as its (constituent) units (elements) approach, i.e. come nearer and nearer the bath in the cell.

According to a preferred embodiment of the invention, the percentage of binder contained in the anode units is such that the raw (unbaked) blocks adhere to each other, not only at their horizontal faces (sides), but at all their faces which are in contact with each other without having to resort to the use of a special binder.

If the raw (unbaked) blocks do not adhere together by themselves, then, adherence can be obtained by swabbing (wetting) the surfaces which must be in contact with a small amount of hot liquid pitch.

The percentage of pitch to be used in the manufacture of the unbaked blocks which constitute the units of the anode in accordance with the invention varies, obviously, according to the particle distribution (granulometry) of the carbon particles used, the nature of this carbon, and the method used in producing the unbaked blocks. The percentage of pitch to be used will vary from about 17% to about 23% of the total weight of the carbon paste; however, these percentages are given by way of illustration only and do not limit the invention in any manner.

The unbaked blocks which, when assembled together, form the anode of the present invention can be produced by any known method: pressing, extrusion, vibration, tamping, or even by a combination of tamping and vibration.

The dimensions (of these unbaked blocks) can vary widely. However, in a preferred embodiment, the length of the elementary blocks (units) can be chosen so as to be equal to the width of the finished anode. This length can thus amount to 1 to 1.5 metres if the anode be intended for use in a high amperage electrolysis cell.

It is advantageous to provide each block (unit) with one or more current inlets which, for example, take the form of steel studs which can be placed in the blocks during tamping or vibration, or else inserted following formation of the blocks into holes preliminarily provided for this purpose.

The annexed figures which are merely given by way of example and not by way of limitation, will enable a better understanding of the invention.

FIGURE 1 represents a sectional elevation, taken perpendicularly to its greatest length, of the assembly of the electrolysis cell with its anode and current inlets;

FIGURE 2 represents a sectional view of the same cell taken along its greatest length;

FIGURES 3 and 4 represent other methods of assembling blocks having substantially the same shape as those of FIGURE 2;

FIGURE 5 illustrates blocks of hexagonal shape, while;

FIGURE 6 illustrates another form of block which can likewise be assembled to form the anode according to the invention.

In these figures: **1** represents the crucible of the electrolysis cell; **2** is the layer of molten electrolyte; **3** is liquid metal disposed underneath this layer; **4**, **4** are the unbaked unit (elementary) blocks, the assembly of which forms the anode; **5**, **5** are the steel studs serving as current inlets to the blocks. The drawings show two and four studs per unit block; however, a different number can be used.

As in the case of all continuous anodes, the studs **5** are pulled out when the anode has been consumed to such an extent that there is a risk that the studs will contact the bath **2**.

As will be seen, the continuous anode of the present invention has several advantages: It is baked by the waste heat of the cells, and, hence, the special baking furnaces can be eliminated. The percentage of pitch used enables the anode to be baked without deformation and, hence, the casing and the movable frames of

the usual Soderberg anodes can be eliminated. These features enable a considerable saving in equipment. A unitary anode can be produced by merely sticking together elementary block units which are piled on each other or interfitted together, this making for great ease of control. The current inlets can be disposed on the sides of the anode and can be pulled out at lower positions because, there is no interference from the frames usual with Soderberg anodes of this type. As a result, there is an improvement in the average voltage drop and, hence, in the efficiency (yield).

To avoid combustion, in the air, of the external periphery of the anode when it arrives in the hot zone, atomized liquid aluminum is projected against its surface prior to its arrival in said zone.

The invention will be further exemplified by the following examples:

Example I

8150 kg. of powdered calcined petroleum coke, having a true (theoretical) specific gravity of 1.98, and having the following granulometry:

[Mesh opening in mm.]

15	5.54	3.33	1.70	0.83	0.36	0.16	0.089
15%	7%	11%	12%	10%	10%	10%	25%

are carefully mixed with 1850 kg. of coal tar pitch having the following characteristics:

Softening point ° C.	82
Residue on coking percent	52
Resins insoluble in benzene and soluble in anthracene oils do	24.4
Residue on coking the above resins do	91.3

The mixing was carried out at 150° C.

To manufacture each elementary unit of the anode, 384 kg. of paste are placed in a rectangular mold 1.20 m. long and 0.50 m. wide, fastened to the vibrating machine.

Following vibration, there is obtained a raw anode element (unit) 1.20 m. long, 0.50 m. wide, and 0.40 m. high.

These anode units, assembled as shown in FIGURE 3, stick perfectly to each other at all their faces (sides), are not deformed during the softening interval and are used without a metallic casing.

Example II

As carbonaceous material, there is used a pitch coke having a true specific gravity equal to 1.96, and comminuted to the same granulometry as in Example I. The quantity of pitch is 17.5% of the total weight of the paste.

The procedure is the same as in Example I.

As will be apparent from the foregoing description, the continuous anode of the present invention is characterized, among other, in that it is casing-less i.e., it is not provided with a sheet metal casing which surrounds the lateral sides of the mixture of carbonaceous material and pitch binder, as in the case of the conventional continuous, self-baking Soderberg anode. In the anode in accordance with the present invention, the lateral sides, i.e., faces of the anode are freely exposed to the ambient atmosphere of the cell.

Referring to FIGURES 1 and 2 of the drawing, conductors 6, 6 connect the studs 5 to a supply of anode current; these conductors also serve to support the electrode. Further, these conductors 6, 6 are connected to suitable mechanism—not illustrated—whereby the conductors can be raised and lowered to enable the progressive feed of the anode, as is well understood in this art.

While for purposes of exemplifying the invention, it has been described with reference to its application in the reduction of alumina to produce aluminum, it is apparent that the invention is also applicable in all instances where an electrode is consumed during an electrolytic process, and the electrode is progressively replaced by an unbaked mixture of carbonaceous material and binder which is baked by the heat evolved during the operation of the process.

We claim:

1. A consumable anode for use in igneous electrolysis cells, comprising a plurality of shaped, unbaked, self-supporting self-adherent contacting units consisting of a mixture of comminuted carbonaceous material and pitch binder which amounts to between 17 and 23 percent by weight of the total weight of the mixture, the lateral sides of said anode being freely exposed to the ambient atmosphere, said units being provided with current inlet studs.

2. A cell for use in igneous electrolysis comprising, in combination: a crucible, a cathode in the bottom of said crucible, a consumable anode above said crucible comprising a plurality of shaped, unbaked, self-supporting self-adherent units each consisting of a mixture of comminuted carbonaceous material and pitch binder which amounts to between 17 and 23 percent by weight of the total weight of the mixture, the lateral sides of said anode being freely exposed to the ambient atmosphere of the cell, said units being provided with at least one current inlet stud.

3. A cell according to claim 2 wherein the several units have reentrant portions which interfit to form a rectangular-shaped anode.

4. A cell according to claim 2 wherein the units are polygonal in shape, and wherein the length of a unit equals the width of an assembled anode.

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