Feb. 17, 1959 W. SYZ ET AL 2,874,103

METHOD FOR REPLACING THE POT OF AN ELECTROLYTIC CELL FOR THE PRODUCTION OF ALUMINUM

Filed Feb. 26, 1957 3 Sheets-Sheet 1

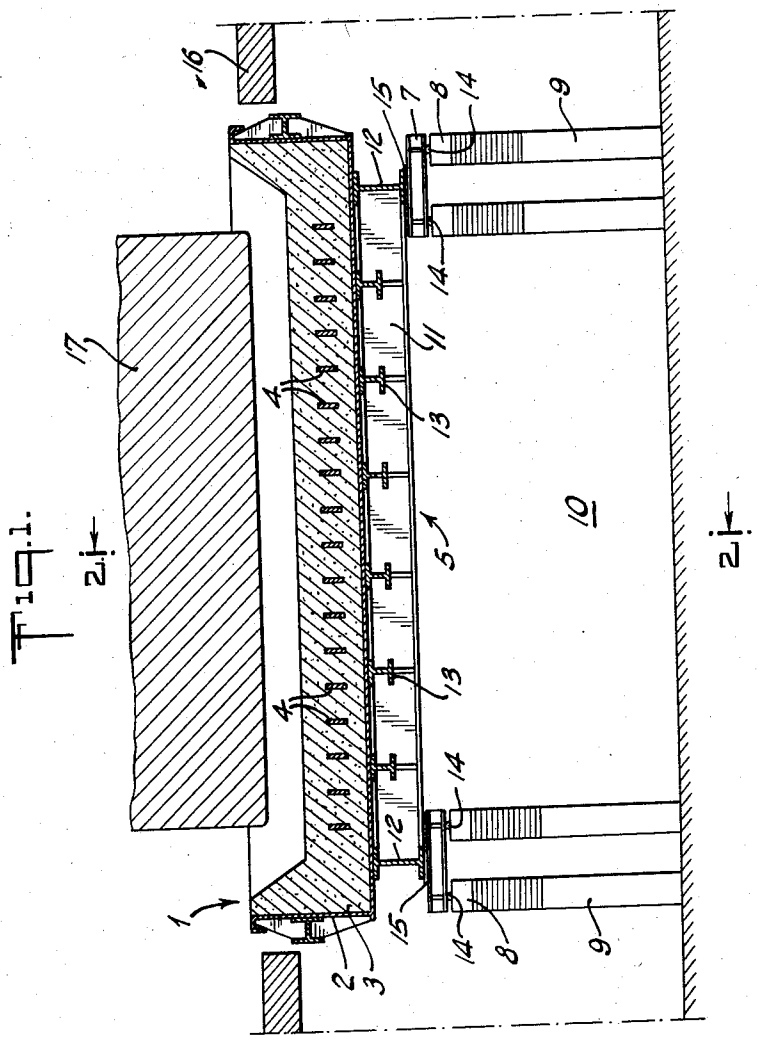


Fig. 1.

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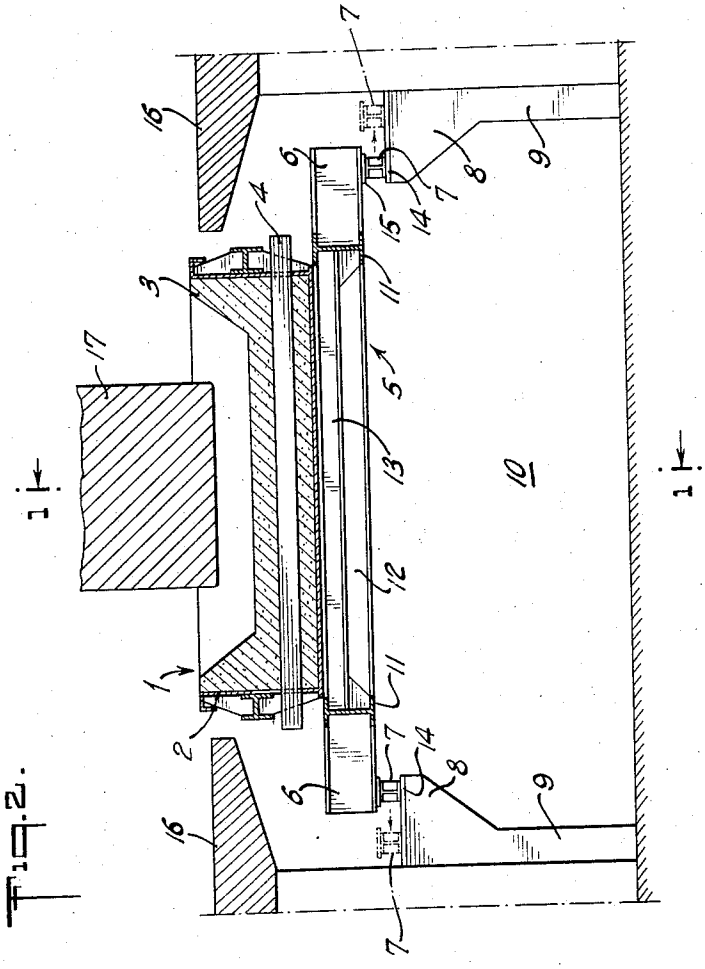


FIG. 2.

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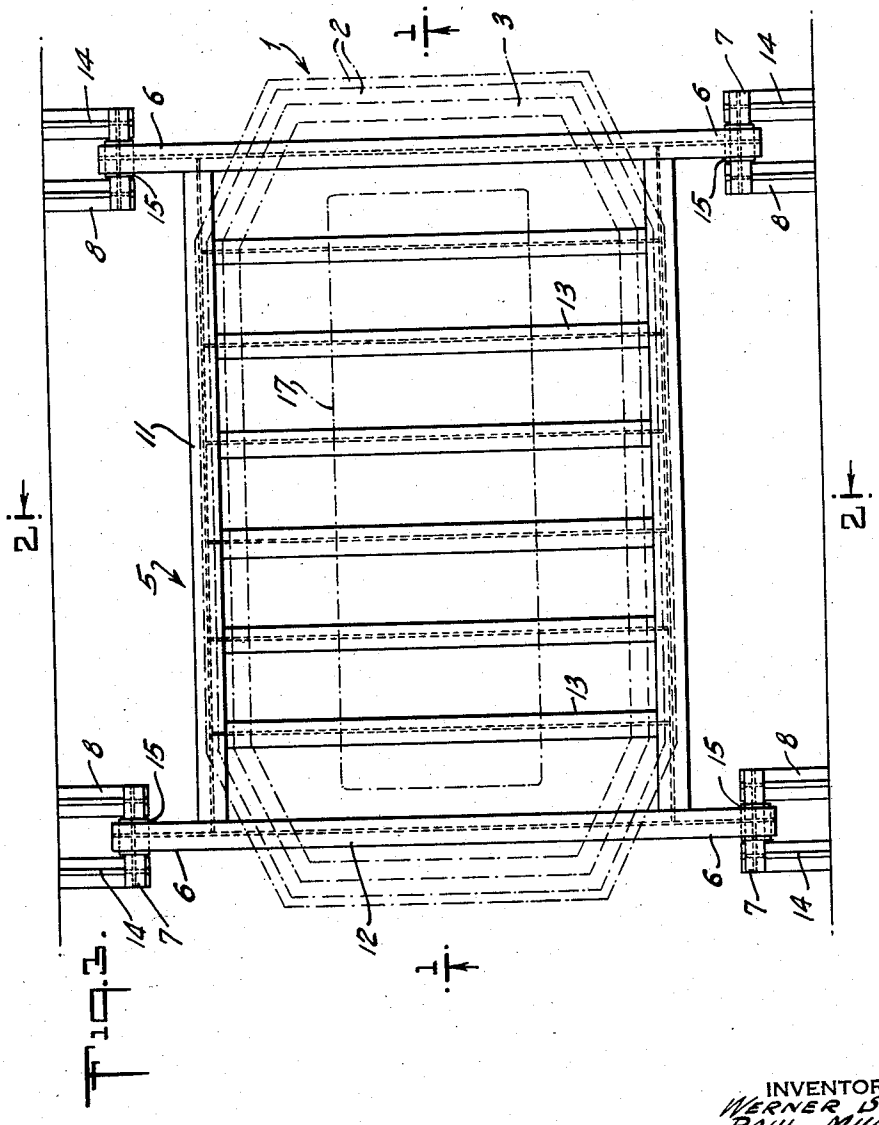


FIG. 3.

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METHOD FOR REPLACING THE POT OF AN ELECTROLYTIC CELL FOR THE PRODUCTION OF ALUMINUM

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4 Claims. (Cl. 204—67)

In the usual electrolytic cells for the production of aluminum the pot containing the fused salt bath is disposed in the floor. The pot consists chiefly of a metallic casing with a carbon lining, metal bars fitted into the carbon bottom for the current supply (cathode bars) and sometimes a masonry of refractory bricks between the metallic casing and the carbon lining. Such a pot has in normal operation an average duration of life of 3 to 5 years, after which time the carbon lining must be repaired or replaced. Also the cathode bars and other parts of the pot may require repair after this.

The repair of the pot is carried out on the spot. For this purpose the cell must be electrically shortcircuited and the anode must be lifted out of the melt. Then the fused metal and the electrolyte are pumped out of the pot. After cooling, the remainder of the electrolyte and of the metal as well as the damaged carbon lining are broken up by means of a pneumatic rammer and shoveled out. If necessary also the cathode bars and other parts of the pot are removed.

Thereafter the reconstruction of the pot is carried out in the inverse sequence. The new carbon lining is built up from prebaked carbon blocks or by ramming or pouring an unbaked carbon paste, for example according to the method disclosed in the United States Patent 2,378,142. Then the prebaked or self-baking anodes are put into position and the current is switched on. Normally the current is switched on with its whole intensity at once, that means that the current is built up to its full intensity within a few minutes. But it is also possible and advantageous for the strength of the carbon lining to use a shunt so that the current intensity may be raised from zero to its maximum at will. As soon as the carbon lining is baked or has attained the desired temperature in the case of prebaked blocks the fused electrolyte can be filled in and the cell put again into operation.

But this mode of working presents some disadvantages: The whole repair of the pot lasts 3 to 4 weeks. During this time the cell is not in operation. If a series of cells has to be fully utilized, there must therefore be available a reserve of 5 to 10 percent of the whole number of pots; but this is only possible with a great capital investment. The repair is carried out in the pot-room, that means under complicating circumstances, causing a high expenditure of working hours. As the repair is carried out on the spot, mechanization is hardly possible. These repairs interfere with the normal operation in the pot-room. The baking of the repaired carbon lining is too brusque if the current is switched on to the full intensity at the very beginning; fissures arise and carbon pieces break off or the baking is unequal, thereby decreasing the life of the pot. As a result a carbon lining had to be repaired after a few months, whereas normally it should be working for 3 to 5 years. When using a shunt it is possible to control the baking process, but usually one takes no advantage of this possibility because the use of a shunt, for example for 100,000 amperes, is very complicated and wearisome. Moreover the anodes are worn by scaling off during the baking of the carbon lining, this also causing losses.

To avoid these disadvantages several measures have been proposed, which are described for example in the book of Fulda and Ginsberg, Tonerde und Aluminium, II. Teil, Aluminium, Berlin 1953, pages 64 to 66 and 72 to 73. In a pot-house of an aluminum reduction plant the pots were placed on a steel scaffold free over a cellar-room of a height of over 3 meters and were lowered to one-third into the working floor. It was then possible to replace the used up pots by sinking them down into the cellar and lifting a new one into its place. In order to bake the new carbon lining of the repaired pots the latter were put into a baking furnace and heated slowly within 6 to 8 days to a temperature of 900° C., held at this temperature for 2 days and cooled carefully within 5 to 6 days. This method has been carried out with cells of a current intensity of 12,500 to 13,000 amperes, but later on it was abandoned as frequently afterwards in the working cell pieces of the carbon bottom as thick as the bottom were torn off. At first the carbon bottom built up on a cathode plate was made in one piece with the carbon side walls and baked. Later on the carbon bottom was baked separately and the side walls were rammed only after baking of the bottom. Sometimes the side walls were also made from prebaked carbon blocks.

Through prebaking the new carbon lining outside the pot-line it was possible to reduce considerably the time in which the cell was not working. But there were other disadvantages: The cooling of the carbon lining after prebaking made it necessary to heat it again after reinstalling the pot. This heating took much time and the temperature change was the cause of the above mentioned breaking off of carbon pieces from the pot lining. The heating of the whole pot in a coke-fired furnace had the further disadvantage that the pot casing was subjected to heavy scaling and warping; moreover with increasing size of the pots the construction and operation of the furnace encountered considerable technical difficulties and needed high investment costs. For all these reasons the method of prebaking the pots in coke-fired furnaces, which method had been carried out on an experimental scale 20 years ago, has been abandoned.

Since then the size of the electrolytic cells for the production of aluminum has been increased many times. Today the carbon bottoms are no longer built up on a cathode plate; the current is fed to the carbon bottom by means of cathode bars embedded in it. One bakes always the green rammed carbon bottoms on the spot by passage of current.

It is an object of our present invention to eliminate the disadvantages of the known modes of operation and to provide a method for replacing the used up pots with embedded cathode bars with a minimal break-down also with electrolytic cells of a current intensity of 60,000 amperes and more.

According to our invention the whole carbon lining of the new pot is baked outside the cell series, preferably by passage of electric current and the pot is placed at a temperature of 500° C. or more, preferably at red heat, in the series.

The carbon lining of the pot may be made either from a conventional green carbon paste poured or rammed into the casing, or from prebaked carbon blocks stuck together by means of unbaked carbon paste or from unbaked, pressed carbon blocks. In each case it is necessary to heat the pot in order to bake either the whole carbon lining or at least the joints between the carbon blocks; in the latter case also the temperature of the whole lining is raised to the baking temperature.

The baking of the carbon lining is carried out preferably according to the method described in the United States Patent 2,378,142. The lining is heated slowly up to 700–800° C. Preferably one holds it at this temperature till the pot is needed for replacing a damaged pot. That is to say that the heating of the pot is discontinued only just before bringing the pot to the desired place. As a result, the pot cools only during the steps of transporting, installing and filling with the electrolyte. These operations can be carried out within 1 to 2 hours. Because of its heat capacity the pot cools during this time only by 50 to 100° C.

The method according to our invention has several advantages. The new pot is already almost at the operating temperature. After installation it must be heated only from about 500 to 700° C. up to 950° C. This can be done rather quickly and makes it possible to apply at once the full current intensity without a shunt.

As the pot does not cool down to room temperature after the baking of the carbon lining and as it is therefore not necessary to heat it to working temperature after installing, it is not subjected to strong temperature changes, so that the main cause of fissures is eliminated.

The whole time required for replacing a used pot from the moment of switching off the current of the cell till the moment of starting the electrolysis in the new pot is cut down to a minimum.

The replacement of the pot may be done by sinking the used up one down into a cellar-room and conveying it away, for instance on a lorry, or by lifting the pot and removing it above-ground. In the latter case it is however necessary to first remove the anode.

It is a further object of our invention to provide a pot which may be advantageously used for carrying out the method according to our invention. A preferable embodiment of this pot is shown in the accompanying drawing in which Fig. 1 is a longitudinal section through the pot along the line 1—1 of Figs. 2 and 3, Fig. 2 is a cross-section through the pot along the line 2—2 of Fig. 3 and Fig. 3 is a plan view of the supporting frame for the pot.

The pot **1** consists of a metal casing **2** and a carbon lining **3** in which the cathode bars **4** are embedded. The pot **1** is placed over the passable cellar-room **10**.

The casing **2** is welded on a supporting frame **5** of strong I-beams. On both longitudinal sides the supporting frame is provided with two projecting parts **6**, each resting on a supporting beam **7**, placed on the projections **8** of two consoles **9**, the supporting beams **7** being arranged removable on the projections **8**. The whole width of the supporting frame must be smaller than the distance between the opposite consoles beneath their projections **8**, so that the pot after sinking down can be conveyed away horizontally together with the supporting frame.

In a preferable embodiment the supporting frame consists of two cross-beams **12** with projecting ends **6**, connected by two longitudinal beams **11**, and other cross-beams **13** supporting the pot **1** between the two longitudinal beams **11**.

The projections **8** of the console are provided with a metal slip plane **14**. On each supporting beam **7** is mounted an isolating plate **15**, isolating the supporting frame electrically against the earth. **16** designates the working floor of the pot-room. Over the pot **1** is suspended the anode **17**.

For replacing a pot, a lorry is placed beneath this pot, this lorry consisting chiefly and preferably of a frame

mounted on mobile axles and provided in its four corners with spindles. These spindles are motor driven and every two on one side carry a girder beam. The distance between both girder beams corresponds preferably to the distance between both longitudinal beams **11** of the supporting frame.

The lorry is placed beneath the pot with the girder beams just below the longitudinal beams **11**. By operating the spindles the pot is lifted, so that the supporting beams **7** are released. The supporting beams **7** are removed and the pot can be sunk down, the projecting parts **6** of the frame moving down between the two consoles **9**.

It is also possible that each projecting part **6** of the frame is supported only by one console **9**. In this case the pot is lifted slightly laterally displaced and sunk down, the projecting parts **6** moving beside the consoles.

The new pot having a temperature of red heat, is brought on a second similar lorry, lifted and after placing again the supporting beams **7** on the projection **8** of the consoles **9** set down on these supporting beams. Thereafter the bus bars for the electrolysis current are switched in again.

By the possibility of a quick replacement of a used pot also the anodes are preserved from great burning losses and from too great cooling, the formation of fissures being therefore avoided.

What we claim is:

1. The method of replacing the worn pot of an electrolytic cell in a cell line in the production of aluminum from a bath of molten fluorides, which method comprises baking outside the cell line a fresh carbon lining on a replacing pot while the latter pot is outside the cell line, maintaining the temperature of the fresh baked carbon lining in the replacing pot at a temperature of at least 500° C. until said replacing pot is installed in the cell line, replacing the worn pot in the cell line by the replacing pot while the baked carbon lining in the latter pot is at said temperature, and placing the latter pot in operation in said cell line while its baked lining is at said temperature, the fresh carbon lining in said replacing pot being maintained at said temperature continuously throughout the operations from the time said fresh carbon lining is baked in said replacing pot to the time said replacing pot is placed into operation in said cell line.

2. The method according to claim 1, in which the carbon lining is at red heat when the replacing pot is installed in the place of the used up one.

3. The method according to claim 1, comprising replacing the used up pot by lowering it down into a cellar-room and using pots mounted each on a metallic frame provided on both longitudinal sides with two projecting parts resting on horizontal projections of consoles when the pot is in the cell series, the width of the supporting frame being smaller than the distance between two opposite consoles beneath their projections, so that the pot after lowering together with the supporting frame can be conveyed away horizontally.

4. The method according to claim 1, comprising replacing the used up pot by lowering it into a cellar-room and using pots mounted each on a metallic supporting frame provided on both longitudinal sides with two projecting parts resting on supporting beams placed on horizontal projections of two consoles when the pot is in the cell series, so that the pot may be lowered between the consoles when the supporting beams have been removed.

No references cited.