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Mail address:
680045, g. Khabarovsk, ul. Putevaya, 1, kv. 63, KIDAKOV SERGEJ VLADIMIROVICH

(72) Inventor(s):
Kidakov Sergei Vladimirovich, (RU)

(73) Proprietor(s):
Kidakov Sergei Vladimirovich, (RU)

(54)PRODUCTION OF ALUMINUM WITH A MOVING ELECTROLYTE IN AN ELECTROLYSER

(57) Abstract:

FIELD: metallurgy.

SUBSTANCE: present invention relates to nonferrous metallurgy, in particular, to a structure of electrolysers for producing aluminum. An electrolyser for producing aluminum containing an electrolysis chamber, a cathode and anodes, an input for supplying an aluminum oxide-saturated molten electrolyte, an outlet for the aluminum oxide-depleted molten electrolyte on the other side of the chamber. The cathode is made in the form of a hearth with an inclination ensuring movement of the electrolyte by gravity along the hearth towards the outlet for the aluminum oxide-depleted electrolyte. A bath is located in the front part relative to the flow of the solution for constant removal of excess aluminum. The electrolyser comprises a closed circuit ensuring circulation of the electrolyte with the dissolved aluminum oxide and configured to uniformly saturate the electrolyte with aluminum oxide outside of the electrolysis zone during movement thereof from the outlet to the input of the electrolyser. The anodes are made of a pseudo-alloy of copper and tungsten.

EFFECT: increase in the output of aluminum with lower electricity consumption.

5 cl, 2 dwg

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1. Field of technology.

The invention relates to the metallurgy of non-ferrous metals, in particular to the design of electrolyzers for the production of aluminum.

2. Prior art.

There are chemical methods of obtaining aluminum and methods using electrolysis. Chemical methods have a high cost of aluminum produced and low productivity. The most productive chemical method of obtaining is magnesium thermal reduction of aluminum trichloride (patent no. RU0002583214 dated May 10, 2016, author Begunov Albert Ivanovich).

Much more productive is the production of aluminum using electrolysis, discovered in 1808 and significantly improved in 1886. French engineer Paul Heroux and American student Charles Hall. Progress in the technology of electrolysis production of aluminum occurs in the following areas:

- finalization of the design of the electrolyzer as a whole - invention No. EA 201990207 dated June 28, 2019 by Liu Xinghua;

- refinement of the supply of aluminum oxide - invention No. RU 0002454490 dated 06/27/12 authors Petr Vasilievich Polyakov, Aleksey Mikhailovich Vinogradov, Evgeny Viktorovich Nikitin, Aleksandr Vladimirovich Krasovitsky;

- refinement of the chemical component of the aluminum chloride electrolysis process - Invention No. US 4919771 dated April 24, 1990 by Wilkening Siegfried.

From the prior art and in production, it is known to pass a metal melt through a filter to remove insoluble particles (non-metallic inclusions, etc.). As filters, special grades of fiberglass with a mesh size of about 1 mm or a steel mesh are used. The most efficient filtration of melts through grain and sintered porous filters. Grain filters are a 30-60 mm layer of grain pieces with a diameter of 5-15 mm. Sintered porous filters have pores up to 0.5 mm in size. Both of these types of filters are capable of retaining very small inclusions, up to 20-30 microns in diameter. It is not known from the current state of the art to use such filters for pre-purification of the aluminum melt inside the electrolytic cell.

All found inventions related to the electrolysis production of aluminum slightly improve the technology without changing it drastically. All improvements do not change the main disadvantages of aluminum electrolysis production:

- huge power consumption

- unevenness of the electrolysis process due to the use of uneven burning carbon anodes,

- uneven supply of aluminum oxide in the electrolysis zone These shortcomings are significantly reduced by the present invention. 3. Disclosure of the invention.

The essence of the presented invention is: increasing the intensity of the electrolysis process at a lower consumption of electricity by gravity movement of an electrolyte saturated with aluminum oxide along the bottom of the electrolytic cell and using metals or their alloys with high conductivity, refractoriness, corrosion and chemical resistance as anodes.

4. The purpose of the invention are:

- high intensity and uniformity of the aluminum oxide dissociation reaction

on the constituent chemical elements - aluminum and oxygen under the influence of current, which excludes the anode effect (blocking of the anodes by a gas film) and the precipitation of aluminum oxide, which disrupts the efficiency of electrolysis,

- maintaining the maximum saturation of the electrolyte with dissolved oxide aluminum between the anodes and the cathode (hearth),

- flushing of emerging oxygen bubbles from the anodes by the flow of electrolyte, reducing anode effect and reactions of oxidation and destruction of anodes, increasing the wettability of anodes by electrolyte,

- Saving electricity on high conductivity and low electric anode resistance.

These factors make it possible to achieve a greater yield of aluminum at a lower cost of electricity. Also, the technological process of the invention makes it possible to obtain oxygen instead of carbon dioxide.

5. This is achieved by:

- in the electrolysis chamber circulation of electrolyte with dissolved aluminum oxide in a closed circuit,

- due to the high viscosity of the electrolyte with dissolved aluminum oxide, the level the supply of the electrolyte mixture is higher than the level of its outflow, which ensures self-flow,

- uniform saturation of the electrolyte with aluminum oxide occurs outside the zone electrolysis using mixing and regulation of additives,

- into the electrolysis chamber, an electrolyte solution with dissolved aluminum oxide is fed evenly to move evenly between the anodes and the cathode

- the deposited aluminum flows down by gravity along the hearth, which has a slight slope in the direction of the bath, located in front of the flow of the solution, excess aluminum is constantly discharged to the outside for further processing, ensuring a constant level of aluminum on the hearth,

- molten aluminum collection bath can be used for coarse cleaning from insoluble particles (non-melted, non-metallic inclusions, etc.),

- oxygen released on the anodes, in order to avoid blocking the anodes from the solution and entry into a chemical reaction is constantly discharged upwards and into the system of removal and purification of gases,

- streamlined anodes are used for efficient separation and removal of oxygen (washing out of bubbles) and vibration of the anodes of optimal frequency, the more oxygen is separated from the output, the less it will participate in the reversible oxidation reaction of aluminum,

- released oxygen can be purified and used in industry, transport or medicine,

- anodes must be made of refractory metal or high-temperature alloy electrical conductivity, low electrical resistance, corrosion and chemical resistance, presumably - a pseudo-alloy of copper and tungsten.

Separately, to the presented invention, it is recommended to organize the release of finished products at plants for the production of aluminum from aluminum oxide. This achieves energy savings for reheating / melting billets (ingots of various shapes). Saved, cheap electricity is most effectively used in the production of finished products with high added value.

Additionally, information should be added confirming the influence of each of the declared design features on the achievement of the specified technical result, namely, an increase in the intensity of the electrolysis process with less

electricity consumption:

- Electrolyte circulation reduces the process of appearance in the anode space an oxygen cushion that increases electrical resistance and power consumption. The uniform consumption of aluminum oxide in the flowing electrolyte reduces the possibility of an anode effect known in the process of aluminum electrolysis with a decrease in the aluminum oxide content in the anode space of less than 1%, which also reduces the efficiency of electrolysis - increases power consumption and requires additional measures to eliminate the anode effect.

- Vibration is used from the prior art to break off the bubbles gases released on the electrodes and to accelerate chemical reactions (for example, V.A. Pozdneev, V.N. Tsurkin “Low-frequency oscillation of bubbles in a vibrating liquid” 09/28/2001)

- The use of anodes made of chemically inactive materials significantly reduces formation of foam (coal foam when using carbon anodes). Previously proposed anode materials based on: iron, nickel, manganese, titanium, tantalum, zirconium, chromium, niobium, cobalt, vanadium, alloys based on them, carbides and borides of these metals, as well as using composite materials based on refractory ceramics, have from 1.5 up to 50 times greater electrical resistance than anodes based on a composite alloy of copper and tungsten and, consequently, greater electricity consumption during electrolysis. The electrical resistance of carbon anodes is 430-600 times higher than the resistance of a composite alloy of copper and tungsten.

Separately, to the presented invention, it is recommended to organize the release of finished products at plants for the production of aluminum from aluminum oxide. This achieves energy savings for reheating / melting billets (ingots of various shapes). Saved, cheap electricity is most effectively used in the production of finished products with high added value. The methods described in the invention can be applied, inter alia, in the production of refined (purified) aluminum. The refining process, in order to reduce the cost of production, can be included in one technological cycle with the primary production of aluminum.

6. Brief description of the drawings.

Fig. 1 shows an electrolytic cell with a gravity-flowing electrolyte, the following are indicated: 1 - exhaust gases

2 - depleted electrolyte outlet and alumina addition point 3 - molten aluminum outlet

4 - direction of movement of the electrolyte with dissolved aluminum oxide 5 - hearth, cathode

6 - electrolyte with dissolved aluminum oxide 7 - supply of electrolyte saturated with aluminum oxide 8 - anodes made of metal or metal alloy

9 - conductive bus 10 - molten aluminum.

Mixing in the electrolyte of the added alumina occurs when it moves from the outlet to the inlet to the cell.

The cell can be made according to a symmetrical layout with the supply of an electrolyte saturated with aluminum oxide from two opposite sides and the selection of an electrolyte depleted in aluminum oxide in the center.

In FIG. 2A shows a cross section of the anode with a schematic flow around the electrolyte.

Figure 2 shows

8 - anode installed in the cell bath on the anode electrical bus 9 - electrical anode bus

11 - vibrating device.

For simplicity, the drawing does not show elements that are not related to the demonstration of the installation of streamlined anodes.

(57) Claim

1. An electrolytic cell for the production of aluminum containing an electrolysis chamber, a cathode and anodes, characterized in that it contains an inlet for supplying molten electrolyte saturated with aluminum oxide, a drain of molten electrolyte depleted in aluminum oxide on the other side of the chamber, the cathode is made in the form of a bottom with an inclination that ensures the movement of the electrolyte by gravity along the bottom towards the outlet of the electrolyte depleted of aluminum oxide, a bath located in the front part with respect to the flow of the solution for the constant removal of excess aluminum, a closed circuit that circulates the electrolyte with dissolved aluminum oxide and is configured to uniformly saturate the electrolyte with aluminum oxide outside the electrolysis zone when it moves from the outlet to the inlet to the electrolyzer.

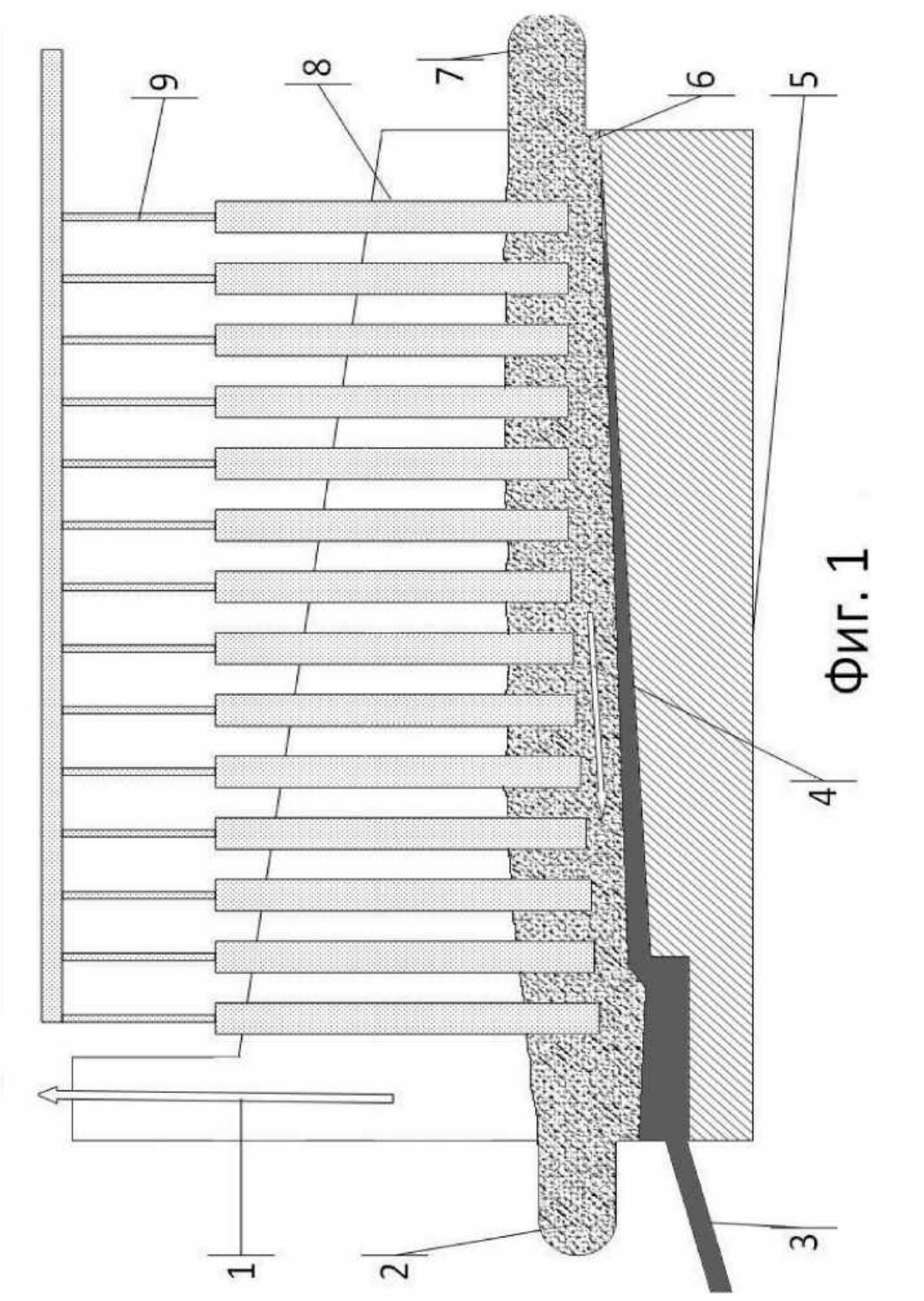
2. The cell according to claim. 1, characterized in that the bath is made with the possibility coarse cleaning of molten aluminum.

3. The cell according to claim 1, characterized in that the anodes are made of pseudoalloy copper and tungsten.

4. The cell according to claim 1, characterized in that the anodes have a cross section streamlined shape.

5. The cell according to claim. 1, characterized in that the anodes are made with the possibility vibrations.

one



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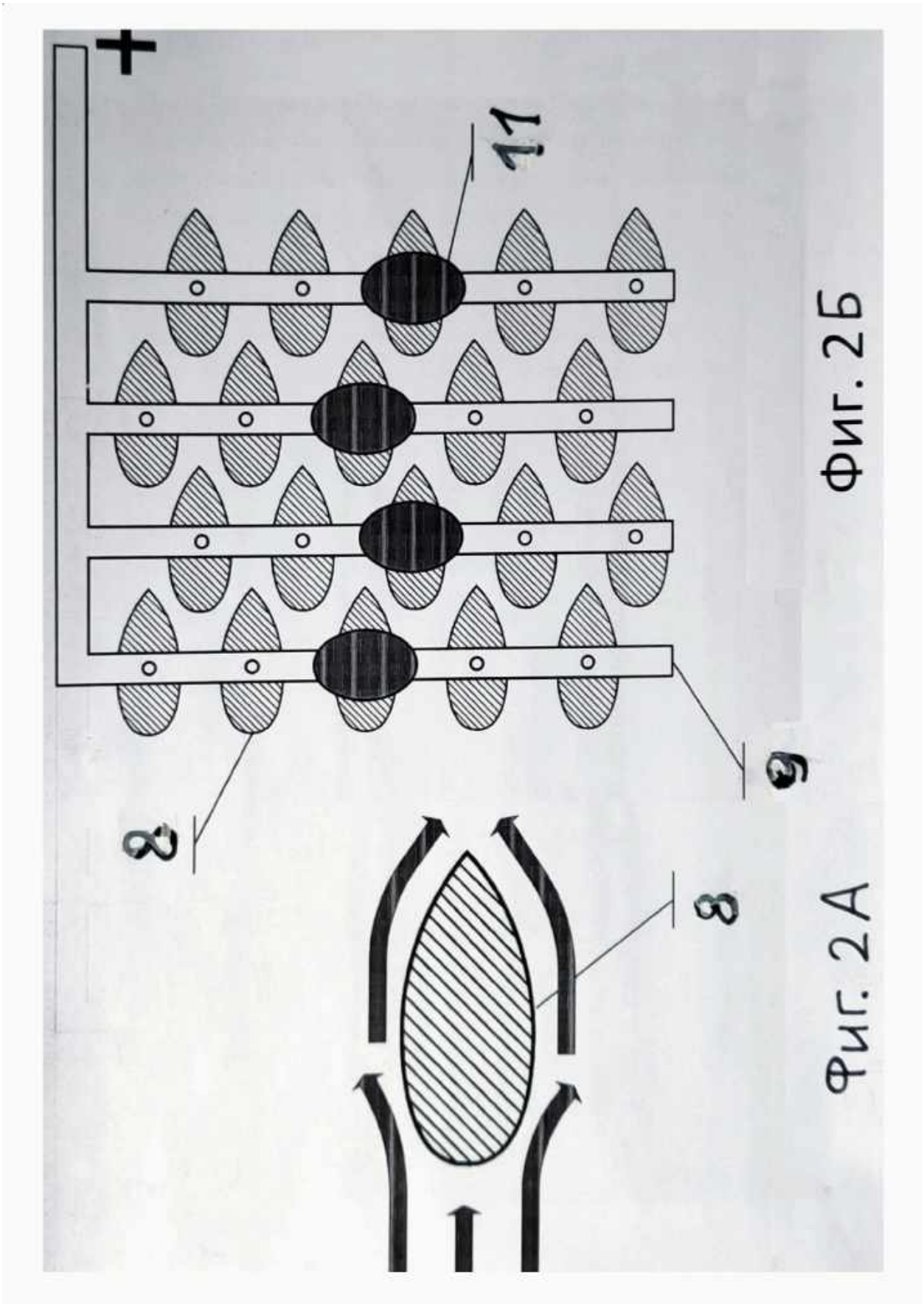

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