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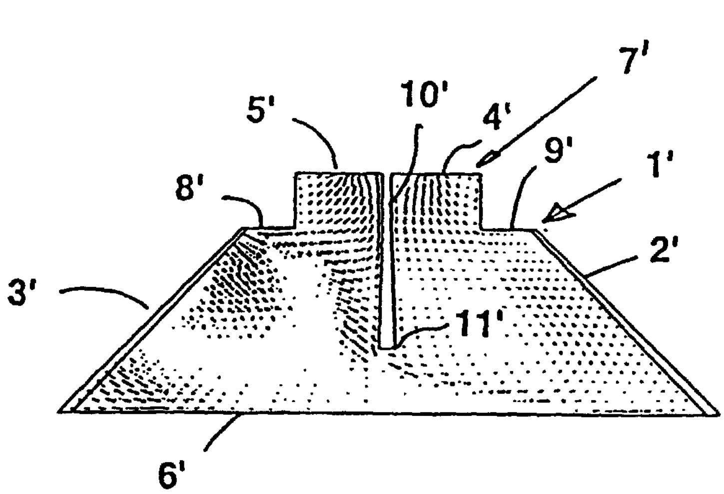
(54) Title: A METHOD AND DEVICE FOR OPERATING AN ELECTROLYTIC CELL



(57) Abstract: The present invention concerns a method and device for reducing emissions of process gases from Hall-Héroult cells to the ambient air. The cells comprise an anode superstructure (1) with covers which can be opened for access to the cell's anodes, among other things. The anode superstructure comprises an extraction system for the removal of process gases, which extraction system is adjusted to remove a standardised quantity of process gases during normal operation of the cell. The extraction system is designed so that an increased quantity of process gases is removed when the covers of the anode superstructure are opened. One embodiment of the present invention includes a vertical partition wall (10') which is located inside the anode superstructure and contributes to an improved flow pattern in the anode superstructure.

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A method and device for operating an electrolytic cell

The present invention concerns the operation of electrolytic cells of type Hall-Héroult. More precisely, the present invention relates to improved control of process gases and limitation of emissions of process gases into the hall atmosphere during maintenance on the cells.

The upper part of an electrolytic cell of type Hall-Héroult usually comprises an anode superstructure consisting of covers or an enclosure including a gas extraction system. Some auxiliary equipment may also be attached such as an anode beam with jacks, crust breakers and a system for raw material dosing inside the superstructure. In order to make the anode superstructure as gastight as possible, covers are constructed which are designed to separate the hall atmosphere from the process gases. The task of the covers is to preserve/increase the underpressure inside the anode superstructure in connection with a given gas extraction. This will lead to the process gases being transported into the anode superstructure and on out to collection channels to a greater or lesser extent, depending on the design of the system. At a constant extraction quantity, the system must be dimensioned so that opening the covers entails a limited emission of process gases to the hall atmosphere in order that the air of the working environment is not of too poor quality.

With the present invention, it is possible to achieve improved collection of the gases, in particular in connection with opening the covers for the performance of maintenance, etc., without the extraction quantity during normal operation being unnecessarily high. By adjusting the extraction quantity so that it increases when the covers are opened, savings are achieved in relation to the prior art as it is expensive to maintain the desired level of collection in an electrolytic cell also when the covers are opened by running the extraction fans at constant "overcapacity", and the gas quantities to be purified become unnecessarily high. Moreover, unfavourable flow patterns in connection with the prior art could mean that process gases could escape from the anode superstructure even if the extraction quantity is increased.

The present invention concerns improvements in the extraction of process gases from electrolytic cells, whereby the disadvantages of the prior art can be avoided. Moreover, the present invention comprises improvements in the flow pattern of the gas inside the anode superstructure, which means that it is possible to achieve improved extraction conditions even with a reduced extraction quantity.

The present invention will be described in the following using examples and figures, where:

Fig. 1 shows a diagram of flow vectors in an anode superstructure with two extraction openings

Fig. 2 shows a diagram of flow vectors in an anode superstructure with two extraction openings and a flow director,

Fig. 3 shows details of an extraction system for use in accordance with the present invention.

Figure 1 shows an anode superstructure 1 with sides 2, 3, a bottom 6, which faces down towards the electrolysis vessel (not shown), a top 7 with extraction openings 4, 5 and gas collecting hoods 8, 9.

The gas extraction system or, more precisely, the gas channels on the anode superstructure can be divided into two separate systems (right/left) which go out to a collection channel which is preferably arranged along the hall wall. Each system has two modes, a normal mode and a forced mode. The size of the normal extraction depends on the current of the electrolytic cell, while the forced extraction may be three times the normal extraction in a "standardised" quantity. Although the gas collection system on the anode superstructure can be divided into two separate parts, it has a common denominator, namely that the overall system works in the same pressure vessel defined by the degree of protection of the electrolytic cell and is generally defined by the cover design and opening area.

The sides 2, 3 may comprise one or more removable covers (not shown) which allow access to the interior of the anode superstructure. When one or more covers are removed from the anode superstructure in order to carry out manual work on the cell, the air which flows in will be much colder than the air already inside the anode superstructure (furnace chamber). Cold air will fall down, producing the phenomenon called "cold slip". On account of the extraction which is always applied to the furnace chamber, the air will flow where there is least resistance, i.e. in the hole where the covers have been removed. Calculations show that over 80 % of all air which is extracted will take the path of least resistance through the hole in the enclosure.

The inflowing cold air will fall down and sweep over the anode carbons and the cover material on the anodes (not shown) and will thus be mixed with process gas while at the same time being heated. On account of the acceleration of the cold air as it falls, the speed will increase and the incoming air will flow over to the opposite side of the furnace chamber. Here it (the cold slip) will meet air which has been sucked in from the opposite side and the majority of the air which comes from the hole in the enclosure will be forced up and into the extraction system. The remaining air which has now been heated and mixed with process gas will be returned to the side where the covers have been removed by large circular flow patterns being established in the cell as shown in Figure 1.

It can be seen from the flow pattern shown in Figure 1 that the above-mentioned "cold slip" generates a vacuum where the gas enters and falls down in the cell. This, in combination with the flow pattern generated in the cell, will lead to the establishment of a speed vector which is in the opposite direction (out of the anode superstructure) under or at the gas collecting hood 8 of the cell. The vacuum generated is filled with hot process gas on account of the large circular flows in the cell. The result of the flow pattern shown in Figure 1 is that process gas can be pressed out of the anode superstructure and escape to the hall atmosphere with associated increased roof emission and not least increased exposure of the operators to process gases. By forcing or increasing the extraction quantity in connection with opening one or more covers, it will be possible, in accordance with the present invention, to reduce the quantity of process gas emitted to the hall atmosphere.

Figure 2 shows an anode superstructure 1' in accordance with the present invention, which superstructure comprises sides 2', 3', a bottom 6', which faces down towards the electrolysis vessel (not shown), a top 7' with extraction openings 4', 5' and gas collecting hoods 8', 9'. The sides 2', 3' may comprise one or more removable covers (not shown) which allow access to the interior of the anode superstructure. Moreover, the anode superstructure comprises a central flow director 10'.

By introducing a flow director in the form of a mainly vertical partition wall, for example of steel plate (St 37 steel) with 10 mm plate thickness and with a given distance from the lower edge of the partition wall to the surface of the cathode in the electrolysis vessel, for example 1000 mm, and which also as a maximum covers the area from one end to the other in the anode superstructure, it will be possible to establish a changed, more optimal flow pattern in the anode superstructure. The flow director 10' will lead to dramatic changes with regard to the potential for removing/draining process gases from the anode superstructure to the extraction system for further processing. The working environment will be improved in connection with the performance of manual work on the electrolytic cells. The location of the flow director 10' in the centre of the furnace chamber at a suitable distance from the base of the cathode and thus the crust over the bath will allow it act as a flow director for the process gases and is of particular importance in connection with the performance of manual work on the cell for which the side covers must be opened.

When changing the carbon or in connection with routines in which up to three covers are removed from the anode superstructure and forced extraction is on, the partition wall which is mounted in the centre of the furnace chamber will act as a flow director in that passing gas which, on account of the "cold slip", flows under the partition wall, is caught by the gas extraction 4' working on the opposite side. It will no longer be possible to maintain such large circular flow patterns as those shown in Figure 1 with associated return transport of hot gas and generation of overpressure at the gas collecting hood on the side on which the covers are removed. On the side on which the covers are removed, the gas extraction will work under almost ideal conditions and the gas will take the path of least resistance, i.e. into the anode superstructure and straight up into the gas channel. As cold gas is heavier than hot gas, the "cold slip" and the gas extraction on the same side will work together and generate a speed vector which is directed into the anode superstructure and which is greatest parallel to the gas collecting hood 8' (horizontal gas collecting hood). The phenomenon is shown in principle by the vector indications in Figure 2.

With such a flow director mounted centrally in the cell, the underpressure in the enclosure can be maintained more easily with a lower total extraction quantity than is the case without the flow director. In order for the system to work as intended, it is necessary for the underpressure at or under the gas collecting hood around the anode suspenders (not shown) on the side of the anode superstructure on which the covers have been removed to be of a certain size, for example greater than 3-4 Pa, so that process gas is kept inside the enclosure. With the flow director mounted, the emission to the hall atmosphere and thus the working environment will be improved and the gas extraction as a system will work better.

The flow director may also be established in another manner. For example, it is possible to place silos for feeding oxide, fluoride, etc. and other equipment inside the anode superstructure, which silos and equipment are adapted so that, from the point of view of flow, they will function as flow directors with regard to the transport of process gas from the anodes through the crust and cover material and to the extraction system, which takes care of the further transport of the gases, for example to purification or fluorine recovery. This can be done by the equipment physically dividing the furnace chamber into two separate parts, each connected to a separate extraction system which leads to the collection channel. Such division of the interior of the anode superstructure can be improved by the equipment as a whole constituting a tight wall along the entire length of the furnace chamber with a suitable opening down towards the electrolysis vessel so that a physical partition wall is formed equivalent to the flow director described above. To establish such a partition wall, any openings between the silos and other equipment can be sealed using sealing elements such as plates, etc. (not shown).

Figure 3 shows details of an extraction system for use in accordance with the present invention. The figure shows a section of the anode superstructures 20, 21, 22, 23, 24 in accordance with Figures 1 and 2. As the figure shows, the anode superstructure 21 is equipped with two extraction channels 25, 26 which are connected to outlet connection pieces 27, 28 respectively. The connection pieces are connected to branches 33, 35 and 34, 36 respectively. Branches 35 and 36 are connected to a collection channel 29 for normal extraction, while branches 33 and 34 are connected to a channel 30 for forced extraction. Channel 30 can serve a given number of anode superstructures. An extraction fan 31 is mounted in the end of the channel and has an outlet which is connected to the collection channel. Moreover, a three-way valve (not shown) may be arranged in connection with the branch (at the transition between each of the outlet connection pieces 27, 28 and the branches 33, 35 and 34, 36 respectively).

The extraction system works as follows:

During normal operation, the process gases are extracted from the electrolytic cells via the anode superstructures 21 and outlet connection pieces 27, 28 and directly into collection channel 29 via branches 35 and 36. In this situation, the three-way valve is in such a position that it shuts off flow to branches 33, 34. If one or two or more covers in the anode superstructure are opened, extraction fan 31 starts and the process gases are sucked through branches 33 and 34 with the result that the speed and the volume sucked through outlet connection pieces 27 and 28 increase, for example to three times normal extraction. In this situation, no process gas passes through branches 35 and 36 as they are shut off by the three-way valve while fan 31 is in operation. Extraction fan 31 and channel 30, which constitute the primary components of the forced extraction, can be adapted so that they expediently cover the desired number of cells.

Claims

1. A method for the removal of process gases from electrolytic cells, particularly cells of type Hall-Héroult, where the cell comprises an anode superstructure with covers which can be opened for, among other things, access to the cell's anodes, and where the anode superstructure also comprises an extraction system for the removal of process gases, which extraction system is adjusted to remove a standardised quantity of process gases during normal operation of the cell,
characterised in that
the extraction system is designed so that an increased quantity of process gases is removed when the covers of the anode superstructure are opened.

2. A method in accordance with claim 1,
characterised in that
the process gases are extracted in such a way that a flow pattern is initiated in the anode superstructure which allows emissions to the ambient air to be limited.

3. A method in accordance with claim 2,
characterised in that
the flow pattern initiated is such that air which enters through an opening in the anode superstructure is removed from the anode superstructure mainly without returning to the area at this opening.

4. A device for use in connection with an electrolytic cell, in particular cells of type Hall-Héroult, comprising an anode superstructure with sides 2, 3, which has covers which can be opened, end walls, a bottom 6 facing down towards an electrolysis vessel and a top (7) connected to an extraction system for continuous extraction of process gases during the operation of the cell,
characterised in that
the extraction system comprises at least one and preferably two extraction openings which extend in the longitudinal direction of the cell and that the extraction system comprises means for increasing the quantity of process gas which is extracted, in particular when one or more covers are opened.

5. A device in accordance with claim 4,
characterised in that
the anode superstructure comprises an internal, vertical wall which extends down from the top of the anode structure towards the electrolysis vessel in the longitudinal direction of the cell.

6. A device in accordance with claim 5,
characterised in that
the vertical wall is mounted between the extraction openings in the top of the cell.

7. A device in accordance with claim 5,
characterised in that
the vertical wall partly comprises process equipment such as a silo (silos) for feeding oxide and/or fluoride.

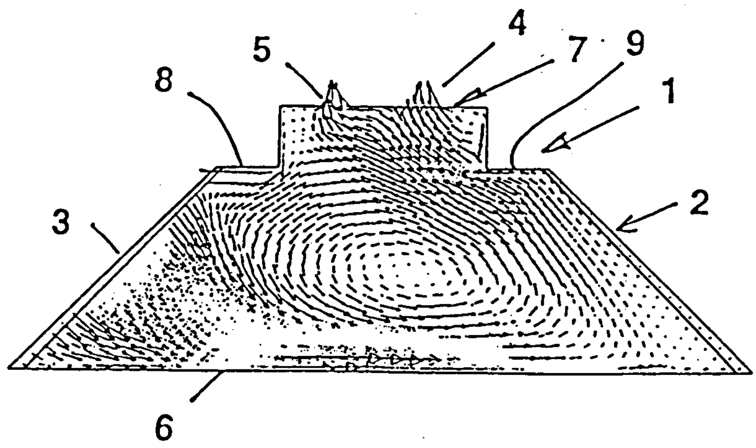

Fig. 1

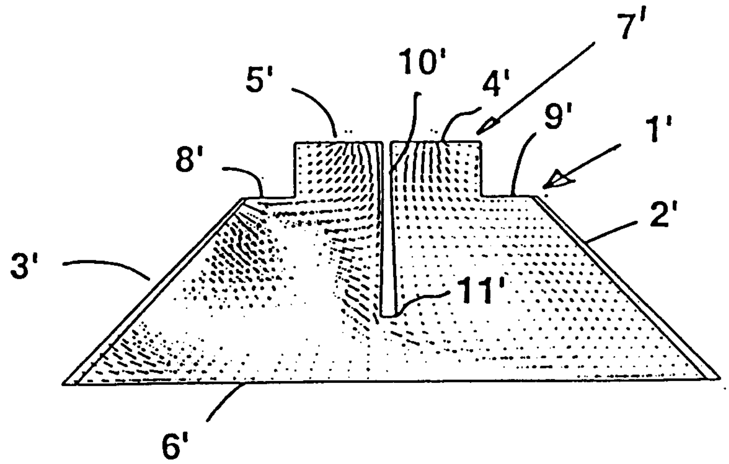

Fig. 2

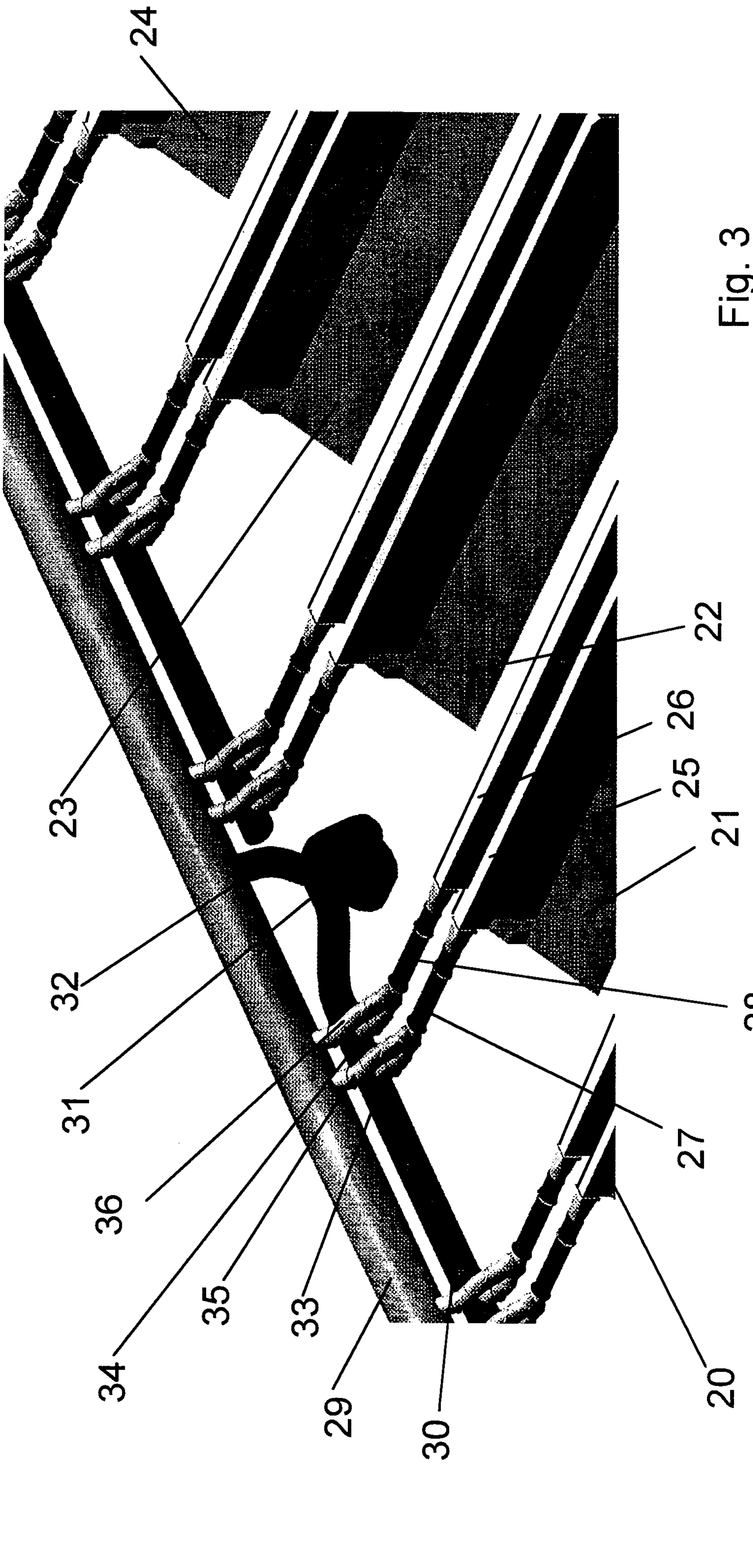

Fig. 3

INTERNATIONAL SEARCH REPORT

International application No.
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A. CLASSIFICATION OF SUBJECT MATTER

IPC7: C25C 3/22

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC7: C25C

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

SE,DK,FI,NO classes as above

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

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[X] Further documents are listed in the continuation of Box C. [X] See patent family annex.

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Date of the actual completion of the international search	Date of mailing of the international search report
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Name and mailing address of the ISA/ Swedish Patent Office Box 5055, S-102 42 STOCKHOLM Facsimile No. +46 8 666 02 86	Authorized officer Ulrika Nilsson/MP Telephone No. +46 8 782 25 00

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C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

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