

[54] **ALUMINA FEEDER FOR ELECTROLYTIC CELLS**

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[22] Filed: **Mar. 7, 1974**

[21] Appl. No.: **449,098**

[52] U.S. Cl. **204/245**

[51] Int. Cl.² **C25C 3/00**

[58] Field of Search 204/243, 244-246

[56] **References Cited**

UNITED STATES PATENTS

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[57] **ABSTRACT**

For feeding alumina into electrolytic cells for producing aluminum, an inclined supply trough is disposed above the electrolytic cell extending in the lengthwise direction thereof, a plurality of suitably spaced distribution pipes direct alumina from the supply trough into metering receptacles each provided at its lower end with a suitable alumina discharging means feeding through a lateral passage into a discharge pipe emptying into the cell. Operation can be automatic if desired.

7 Claims, 3 Drawing Figures

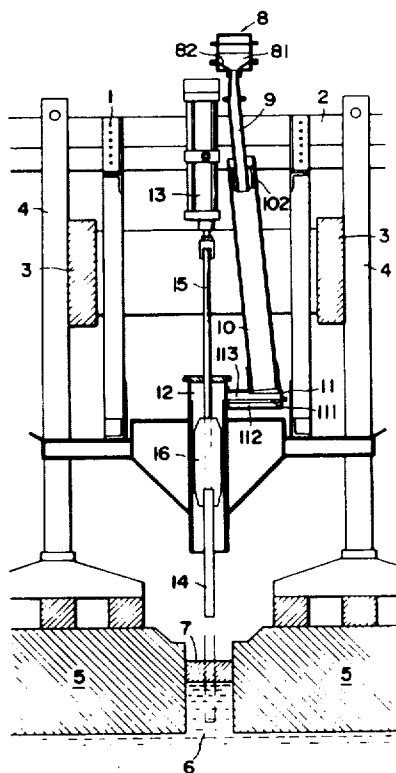


FIG. 1

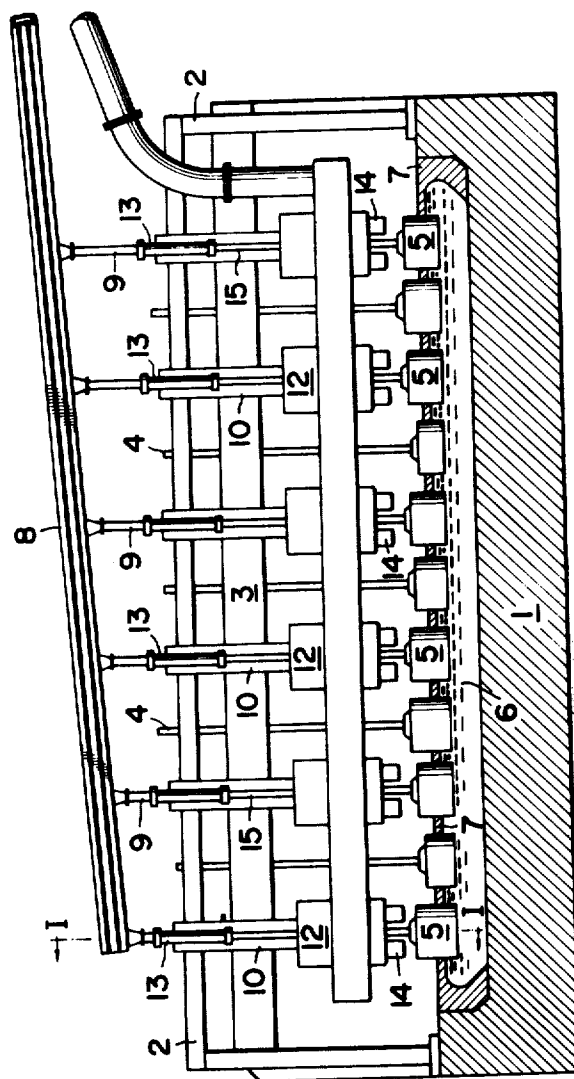


FIG. 2

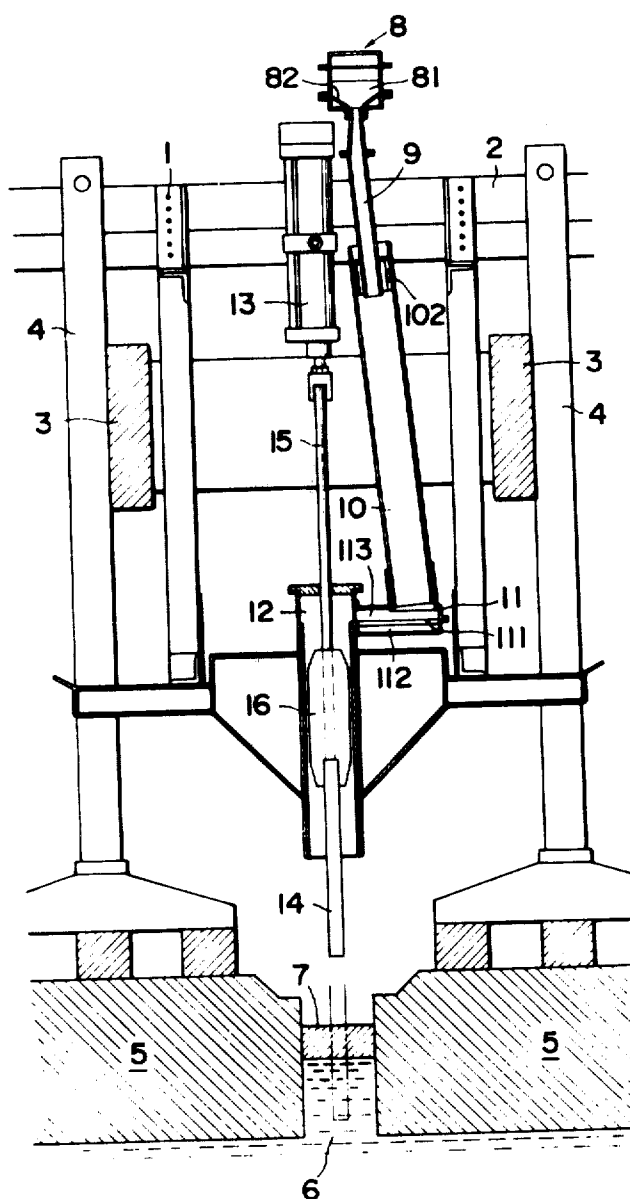
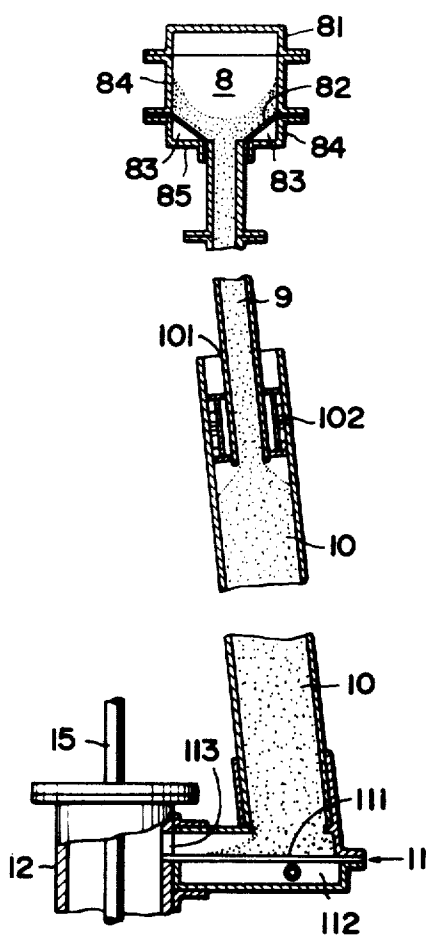


FIG. 3



ALUMINA FEEDER FOR ELECTROLYTIC CELLS

FIELD OF THE INVENTION

This invention relates to an apparatus for feeding alumina into electrolytic cells for producing aluminum.

BACKGROUND TO AND OBJECTS OF THE INVENTION

As is well known in the art, aluminum is obtained through the electrolysis in an electrolytic cell of alumina which is dissolved in an electrolytic bath mainly composed of fused cryolite.

In this electrolytic process for producing aluminum, the aluminum in the electrolytic bath is gradually consumed during the electrolysis and hence must be replenished. Generally, the efficiency of electrolytic production of aluminum is greatly influenced by the concentration of alumina in the electrolytic bath. Accordingly, it is necessary to suitably adjust and control the amount of alumina supplied to the bath in order to maintain a proper concentration of alumina in the bath. Also, if alumina is supplied unevenly into the electrolytic bath, it can precipitate on the bottom of the cell and seriously affect the condition of the cell. Accordingly, it is preferable to supply alumina to supply alumina to the cell in such a way that it is evenly dispersed over the entire bath.

In prior art alumina feeders of this type it has been proposed to provide a hopper and weighing means in the proximity of the electrolytic cell, by which a proper quantity of alumina to be supplied at a time is weighed and transferred through a conveyor to various regions of the cell. With this apparatus, the amount of alumina to be fed at a time can be controlled, but the distribution of alumina in the bath cannot be sufficiently controlled. Therefore, it is very difficult to uniformly distribute alumina over the bath in the cell.

The object of the present invention is therefore to provide an alumina feeder capable of supplying alumina in a proper amount at a number of points distributed substantially uniformly over the electrolytic cell.

SUMMARY OF THE INVENTION

The alumina feeder provided in accordance with the invention comprises an elongated alumina supply trough disposed above the electrolytic cell and extending in the lengthwise direction thereof, a plurality of distributing pipes connected at spaced points along the supply trough, each feeding into a metering receptacle of predetermined volume and provided at its lower end with a discharging means for emptying the alumina in the receptacle into the electrolytic bath.

BRIEF DESCRIPTION OF THE DRAWINGS

The invention will now be described in connection with one embodiment thereof illustrated in the drawings in which:

FIG. 1 is a front view, partially in section, of a multi-electrode aluminum electrolytic cell associated with an alumina feeder according to the invention;

FIG. 2 is a transverse sectional view taken generally along line I—I in FIG. 1; and

FIG. 3 is an enlarged sectional detail view of the alumina supply trough and one metering receptacle shown in FIG. 2.

DETAILED DESCRIPTION OF PREFERRED EMBODIMENT

In the drawings, reference numeral 1 designates the main container body of the aluminum electrolytic cell having a framework structure 2 provided above the cell. Structure 2 supports bus bars 3 and carbon anodes 5 electrically connected to the anode buses 3 by vertical anode suspension rods 4. Within the cell body 1 is an electrolytic bath 6 mainly composed of cryolite and containing alumina dissolved therein. During operation of the cell, a solidified layer or crust indicated at 7 is formed on the surface of the electrolytic bath 6. Up to this point, the description has been of a conventional multi-electrode alumina electrolytic cell which is the context for the present invention which will now be described in detail.

Numeral 8 designates an alumina supply trough, which is disposed above the framework structure 2 of the electrolytic cell and extends at a slight inclination along the length of the cell. Its higher end is connected to an alumina supply source such as an alumina hopper (not shown) situated at a remote point, and its lower end terminates generally adjacent one end of the electrolytic cell.

Supply trough 8 is slightly inclined, a preferable angle of inclination being 2° to 5°, and it comprises a trough body 81 having a rectangular cross-sectional shape and a V-shaped porous false bottom 82, made of cloth, porous plates or the like so as to be permeable to the alumina. False bottom 82 is secured along its upper margins to the opposite side plates 84 of trough body 81 and along its bottom edges to a floor plate 85 of the trough body 81. In this arrangement, compressed air is supplied to an air chamber 83 below the false bottom 82 and passes through the permeable false bottom to bring the alumina resting on the false bottom into fluidized condition for transfer downwardly into a plurality of distribution pipes 9 located at spaced points along the length of trough 8.

Distribution pipes 9 all have the same diameter and are connected to the floor plate 85 of supply trough 8 and extend generally downwardly into the upper ends of metering receptacles 10. The number of distribution pipes 9 is appropriately selected depending upon the size of the electrolytic cell. Each metering receptacle 10 is shaped as a cylinder with a top opening 101 through which the associated distribution pipe 9 is inserted and is provided at its lower end with a discharging means 11. A packing 102 for preventing the overflow of alumina fits slidably between the inner wall of receptacle 10 and the outer wall of the associated pipe 9 and by adjusting the extent of telescoping relation between the pipe and receptacle, the volume of the receptacle can be changed as needed.

The removal of the alumina from the receptacle is effected by means of fluidization through an air-permeable porous floor 111 at the bottom of receptacle 10 and a laterally extending discharge passage 113. An air chamber 112 is provided below floor 111 and when compressed air is introduced into air chamber 112, alumina resting on porous floor 111 is fluidized, and conveyed through discharging passage 113 into cell delivery pipe 12. In the absence of compressed air introduced into the air chamber 112, the alumina remains on the porous material bed 111 at the repose angle as shown in FIG. 3 and does not flow out of discharging

passage 113. Delivery pipe 12 serves to prevent the scattering of alumina being discharged through the passage 113 by leading it onto the electrolytic bath.

The delivery pipes 12 also act as guides for crust crushing chisels 14. These chisels are vertically reciprocated by a vertical drive means 13, which may be a hydraulic cylinder mounted on the cell framework structure 2, to break up the crust 7 which forms on the top of the bath. Numeral 15 designates a vertical drive rod connecting the hydraulic cylinder and chisel 14, guide collar 16 being provided on drive rod 15 for moving the chisels properly through the pipe 12.

With the alumina feeder according to the invention constructed as described above, by introducing compressed air into the air chamber 83 of supply trough 8, the alumina fed into the trough from the alumina supply source, such as a hopper (not shown) disposed outside of the cell 1, is fluidized on the v-shaped porous false bottom 82 and gradually moves down along the inclined surface of bottom 82 to be collected at the lower end of the trough 8.

The alumina gravitates downwardly into the distribution pipes 9 and is accumulated in each of the metering receptacles 10. The receptacle 10 which is located at the upper end of the inclined supply trough 8 is fitted first and then the next receptacle 10 and so on down the trough.

When the last metering receptacle 10 is filled, the supply of compressed air into air chamber 83 is stopped, using preferably a level-indicating device as indicated in FIG. 1, provided in the last receptacle 10 for automatically shutting off the compressed air flow. Then, by introducing compressed air into the air chamber 112 in the discharging means 11 at the bottom of each receptacle 10, alumina resting on the porous floor 111 is fluidized and discharged through the discharging passage 113 into the delivery pipe 12. The amount of alumina discharged from each receptacle 10 into the bath is obviously equal to the sum of the quantity of alumina in the receptacle proper as well as the pipe 9 extending thereinto. This amount depends upon the total length of pipe 9 and the fraction of the length of pipe 9 inside the receptacle 10. Thus, the amount of alumina discharged from each receptacle 10 can be controlled to conform to a predetermined amount by appropriate preliminary adjustment of these lengths. The alumina empties from pipes 12 onto the crust 7, covering virtually all of the top surface of the bath. By actuating the vertical drive means 13 mounted on the framework 2, the crust is broken up with vertically driven chisels 14, thus permitting the alumina discharged onto the crust 7 to be introduced into the electrolytic bath 6 and rapidly dissolve therein.

As has been described, with the alumina feeder according to the invention, the alumina supplied from the inclined alumina supply trough 8 disposed above the electrolytic cell 1 is fed through the distributing pipes 9 connected to the underside of the supply trough into the metering receptacles 10, and after the predetermined amount of alumina is supplied to all the receptacles, they are emptied. This sequence of operation can be carried out by means of a previously programmed timer switch. Thus, a predetermined amount of alumina can be accurately fed into the electrolytic bath without the need of measuring the amount of alumina to be fed each time. Besides, alumina can be fed uniformly from the receptacles to the various regions of

the cell, without the possibility of supplying excessive amounts of alumina to some and not enough to others.

Further, in the usual aluminum production plant there are provided a number of different electrolytic cells, and each cell has its own inherent electrolytic characteristics. This means that the consumption of alumina varies with individual cells. Sometimes, it varies locally even in the same cell. For maximum production efficiency of the electrolytic cells, it is, accordingly, desirable to suitably adjust the total amount of alumina fed to each cell at a given time. Further, in some cases it may be required to adjust the amounts of alumina to be fed to the various receptacles in the same electrolytic cell. With the apparatus according to the invention, the amount of alumina to be fed to each receptacle can be preset by preliminarily adjusting the length of the distributing pipe extending into the receptacle, so that not only the amount of alumina to the bath at a time but also the amount of alumina to be fed to respective regions of the bath can be adjusted, so that production efficiency can be increased even higher.

What is claimed is:

1. Mechanism for feeding alumina from a supply source to an electrolytic cell for making aluminum comprising an inclined generally V-shaped feeding trough receiving alumina from said source, said trough extending over the length of said cell, a plurality of distribution conduits connected to the bottom of said trough at spaced points along its length and projecting downwardly therefrom, a metering receptacle at the lower end of each such conduit for collecting alumina gravitating down such conduit, and discharge means for each receptacle operable to empty alumina collected therein into said cell and comprising means for fluidizing the alumina in said receptacle adjacent the lower end thereof and for delivering the fluidized alumina into said cell.

2. Mechanism as in claim 1 wherein said metering receptacles collect said alumina until all are filled and including means for detecting when the last receptacle along said trough is filled.

3. Mechanism as in claim 2 wherein said discharging means are operated substantially simultaneously in response to said detecting means.

4. Mechanism as in claim 1 including means for adjusting the volume of each of said receptacles.

5. Mechanism as in claim 4 wherein said distributing conduits extend telescopically into said receptacles and the receptacle volume is adjusted by varying the length of the portion of each conduit in each receptacle.

6. Mechanism as in claim 1 including means for fluidizing the alumina in said trough to facilitate gravitation of the alumina in said trough into said distribution conduits.

7. Mechanism as in claim 1 wherein each said receptacle has an open lateral passage in communication at one end with the receptacle interior at the bottom end thereof and at the other end with a delivery pipe opening within said cell, said lateral passage being longer than the vertical projection of the angle of repose of the alumina therein, whereby alumina in said receptacle does not normally flow through said passage, and means for fluidizing the alumina in said lateral passage and conveying the same into said delivery pipe.

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