MACHINE FOR PICKING AND DISTRIBUTING ALUMINUM OXIDE INTO ELECTROLYTIC CELLS

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This invention relates to a machine for use in the introduction of aluminum oxide into the baths of electrolytic cells in the production of aluminum, and for picking the crusts formed on such baths for enabling aluminum oxide loads to be introduced therein.

To the present, the operation of picking the crusts formed on the cell baths and supplying the cells with aluminum oxide had been carried out as separate and distinct operations. Picking was achieved by means of pneumatic picks mounted on automotive vehicles or otherwise suspended from travelling cranes. Aluminum oxide was separately supplied by carriages or trucks having containers or scoops with bottom walls slidable to open position to enable the aluminum oxide to fall therethrough.

By reason of the separate operation, time lag occurred between the picking operation and the feed of aluminum oxide, with the result that a number of deficiencies and drawbacks were experienced, such as exhaustion of gases, heat loss, and the like. Attempts to join the picking and feeding operations, as by the use of compressed air lines, has been found to be subject to high maintenance costs.

It is an object of this invention to produce a machine which is capable of effecting the desired picking operation and feeding of aluminum oxide to the bath, wherein the feeding operation is carried out directly after and substantially as a continuous operation with the picking step, thereby to improve the working conditions; and it is a related object to produce a machine of the type described which can be easily controlled and operated by a single operator.

The and other advantages of this invention will hereinafter appear, and, for purposes of illustration, but not of limitation, an embodiment of this invention is shown in the accompanying drawings, in which:

FIGURE 1 is a schematic elevational view of a machine embodying the features of this invention;

FIGURE 2 is a side elevational view of the machine shown in FIGURE 1;

FIGURE 3 is a sectional elevational view taken substantially along the line x-y of FIGURE 1 showing the pivot, and

FIGURE 4 is an elevational view, partially in section, of the guide means employed in the machine of FIGURE 1.

Briefly described, a machine embodying the features of this invention is adapted to be suspended from trolleys or rails for shifting movement in response to pneumatic, electrical, or mechanical power for servicing any one or more of a group of electrolytic aluminum fabricating cells. The machine consists of the combination of a pneumatic pick and means for bringing the aluminum oxide in the desired amounts into the vicinity of the pick for feeding the load of aluminum oxide into the bath upon completion of the picking operation and substantially as a continuous operation thereon.

In accordance with an important concept of this invention, the pneumatic pick is provided with means for retaining a dosage of aluminum oxide and which embodies adjustable feed openings on the bottom side thereof for distribution of the aluminum oxide to the working zone of the pneumatic pick in feeding aluminum oxide to the bath. As a further feature, the machine embodies semi-elastic conducting members between the body portion of the pneumatic pick and the aluminum oxide container for enabling the passage of aluminum oxide thereto.

In a preferred embodiment of the invention, which will hereinafter be described, the pneumatic oxide-aluminum oxide feed system are suspended from a horizontal support shiftable through a pivot capable of pivotal movement about a vertical axis and which is capable of concurrent linear displacement crosswise, as well as in a direction parallel, with a center line extending lengthwise through a line of cells to enable shifting movement of the pneumatic pick, and aluminum oxide feed above the cells to enable picking of the crust and feed of aluminum oxide to be carried out at any place in any one of the cells in the line. The support is advantageously formed of a bracket which carries the pivoting part and which is guided in its linear displacement along the lengthwise center line of the cells by means of a pair of rails, one of which is located at or about ground level for accepting vertical loads, and the other of which is located a substantial distance above ground level for accepting horizontal stresses due to the inversion movements.

According to a further feature of this invention, the control and operation of the components of the machine is located near the pneumatic pick and aluminum oxide feed, as from a controlled platform which forms a part of the assembly, to enable a single operator to manage the functions of the machine while in the immediate vicinity of the operating parts thereof.

Having outlined the various concepts of this invention, detailed description will now be made of the construction and operation of the machine. It will be understood that the description is given by way of illustration and not by way of limitation, and that various modifications within the skill of the art may be made for various of the parts and arrangements thereof.

The suspended assembly is shown in FIGURES 1 and 2 as including a pneumatic pick 1 having a container section 2 formed with a capacity for a dosage of aluminum oxide, and a control platform 3 located rearwardly of the lined pick and container. The three elements are joined by semi-elastic members of the silent block type to minimize transfer of impacts from the pneumatic pick to other parts of the machine or operator platform. The described assembly is suspended at a level above the baths 4 of the cells from the end of a horizontally disposed arm 5 by means of interconnecting linking members 6 and 7. The arm 5 is mounted between rollers, for example, for linear displacement in a direction crosswise of the line of cells relative to a pivoting part 9. Such actuation may be effected by means of a motor 10 or other power-actuating or displacement means. It will be understood that telescoping arms, pneumatically or hydraulically actuated, could be employed instead of the arm 5 being shiftable between rollers 8.

The rotation of part 9 is along the vertical axis x-y of FIGURE 1, and it is advantageously located in a vertical plane passing through the lengthwise center axis of the line of cells to be fed. The outside contour of the cells is shown diagrammatically at 54.

The overhanging and pivoting means for part 9 is composed mainly of a number of circumferentially spaced-apart rollers 11 mounted integrally on part 9 for rotational movement about a vertical axis. The rollers 11 are formed with splines in their outer periphery for engagement with corresponding grooves in a stationary ring 12. The thus formed pivot, together with the rotation mechanism of part 9, will hereinafter be described in greater detail with reference to FIGURE 3.
As shown in FIGURES 1 and 2, the ring 12 is attached to the overhanging end 13 of a bracket 14 which is provided with rollers 15 at the other end for operation over rails 16 arranged on the ground in parallel relation with the length of rails of the cells, thereby to enable lengthwise displacement of the bracket and elements supported thereby, as by means of an electrical motor 17 or other power-operated means.

The moment of inversion of the bracket responsive to horizontal and vertical force is balanced on the one hand by a pair of rollers 24 fixed to a shaft 25 on which the elevator 23 is mounted, and to which the bracket is attached, whereby it is balanced on a horizontal axis and engaged to position the lateral slings of the rail 16, and, on the other hand, it is balanced in an area spaced upwardly from the rail, as by means of a guiding truck 18 provided with a pair of rollers 19 rotatable about a vertical axis. The latter rollers 19 engage the inner wall of a horizontally disposed rail 20 depending from the outer end portion of a supporting bracket 21, which is anchored to the wall of a building or other stable support. The linkage means between the truck 18 and the body of the bracket 14 will hereinafter be described in greater detail with reference to FIGURE 4.

It will be understood that the ring 12 and the pivot can be supported by movable apparatus other than the bracket 14, such, for example, as by means of a travelling crane, gantry, or the like.

By it being apparent from the foregoing description that the suspension of the system comprising the pneumatic pick 1, the aluminum oxide container 2, and the control platform 3 can simultaneously be moved in three directions, namely, (1) a translation movement parallel to the line of the cells when the bracket 14 rolls on its rails 16 and 20 in response to activation by the motor 17, (2) a translation crosswise of the line of the cells when the arm 5 is displaced linearly through part 1 in response to actuation by the motor 10, and (3) a rotation about a vertical axis preferably offset from the platform when part 19 turns in ring 12 in response to a driving motor (not shown).

Control for operation of the motors is achieved from the control disc 22 on the platform 3, as by means of an electrical connection through a rotating ring-and-shoe contact, with the ring being centered on the axis x-y for maintaining the electrical connection, notwithstanding the relative movements of the parts. Current is supplied to the machine by means of a shoe bearing on the ground rail 21 or one or several trolleys situated, for example, on the bracket 21. The suspended system, and, more particularly, the pneumatic pick and control platform, is electrically insulated from the bulk of the machine, as by means of insulating spacers 23 and 24 interposed between the arm 5 and the bending links supports 6 and 7.

The various described motions enables displacement of the active parts of the machine along all azimuths so as to enable picking and feeding the whole perimeter of the cells which are, in general, arranged lengthwise one after another.

The dust-breaking pick 1 is pneumatically actuated from a compressed-air source comprising a compressor 25 and one or several tanks 26 mounted on the hanger frame. The supply of compressed air is brought in through a stiff lead-in pipe 27 provided with a rotating joint 28 arranged on the rotation axis x-y and thereafter through a flexible tubing 29 between the pivot and the pick.

The container 2, which serves for the distribution of aluminum oxide, is supplied by a hopper 31 of considerably greater volume which is mounted on the top of the hanger body.

Care has to be taken to connect these two containers which are subject to simultaneous rotation and translation relative displacements. The bottom of hopper 31 is connected with a lead-in pipe 32 for fluidizing the aluminum oxide, and it is provided with a chute 33 over which the aluminum oxide flows from the reservoir container 31 to the vicinity of the axis x-y of the pivot situated at the end of the hanger's arm. Thereafter, the aluminum oxide is advanced across the central part of the pivot and into a flexible pipe 34 which, by reason of its deformability, permits the relative movement of the container 2. In order to guide the aluminum oxide to pass through the central part of the pivot, it is desirable to locate all of the mechanical parts which serve for the suspension and control of the part rotating about the periphery of the pivot proper, so as to secure a passage in the central portion of the latter. FIGURE 5 shows an embodiment of a pivot for fulfilling these various conditions.

The part required for suspension is composed of, as indicated above, four rollers 11 the vertical axis 41 being integral with the rotating part 9, and a ring 12 which is welded into a plate 35 integral with the end of the hanger's arm. The rollers 11 are preferably mounted on a roller bearing not shown in the figure. The rollers and the ring are provided with grooves, the profile of which is in the form of a rack, the straight-line flanks of the teeth of which are in the form of conical surfaces. The defined conical surfaces for the ring and the rollers are tangent to one another respectively in the plane determined by the axis of the ring and the axis of each roller.

The moments of inversion applied onto the pivot create contact stresses in the zones of tangency of the described conical surfaces, notwithstanding the directions of these moments. The rotation is controlled by a step-down reduction gear, not shown in FIGURE 3, the pinion of which meshes with a bevel gear 36 integral with the rotating stationary plate 38.

To insure the protection of this device against aluminum oxide dust, it is desirable to provide a number of baffle plate members, represented by the numerals 37, 38, and 39, between the stationary and rotary sections, the last two baffle plates being advantageously coated with oil or other fluid.

Apertures 40 are provided in part 9, between links 37 and 38, in order to minimize the accumulation of aluminum oxide therein. Blades, integral with the rotating stationary plate 35, scrape the aluminum oxide for displacement through the apertures 40.

The overhead chute 33, which leads the aluminum oxide into the reservoir container 2, is connected with a plate 41 which is suitably fluidized by means of compressed air and discharged through the outlet 42 formed on the plate 41. The supplied aluminum oxide is guided to the flexible tubing 34 by means of an inclined sheet plate 43 of conical shape in a manner to prevent entrance of the aluminum oxide into the central part 44 of the pivot defined by a tubular housing which is provided for the compressed air inlet 45 mounted on the rotating joint 28, as well as the electrical cables stretching toward the operating platform.

The distribution of aluminum oxide into the cell baths from the container 2 is preferably achieved through two or more openings provided on opposite sides of the pneumatic pick. The openings are obturated by throttles actuated by pedals arranged on the control platform 3. By way of example, the built-up machine is formed with a container 2 having a distributing dosage capacity of 200 liters, and a hopper 31 of 6,900 liters capacity. The latter can be re-loaded periodically from large pig tanks outside the building.

From a practical standpoint, it would be difficult to maintain a constant distance between the lower guiding rail 16 and the top rail 20, the preferable distance between both rails being of the order of about 5 to 6 meters. Moreover, one or several travelling cranes are installed, generally in the halls sheltering the electrolytic cells, and, on passing of the vicinity of the bracket 21, a travelling crane may well induce a temporary deformation of the top guiding rail 20. It is for this reason that embodying the features of this invention is provided with a system of connection which allow for greater freedom.
of motion between the top guiding track and the hanger's body.

According to an embodiment represented in FIGURE 4, truck 18, provided with the vertical axis rollers 19 which rest on rails 20, is integral with a part 46 extending in a heel 47. The body 14 of the hanger also bears a heel 48 at its top with its vertical wall in spaced parallel relationship with the vertical wall of the heel 47. On the opposite faces of the heels 47 and 48 there are mounted two cups 49 and 50, having therebetween a ball 51 with its center on the middle plane 52 of roller 19. Since the ball plays the part of a ball and socket in compression, it enables the truck 18, the weight of which is balanced by a spring 52 resting on a fixed point 53 of the hanger, to remain constantly in contact to follow the top guiding rail 20.

It will be apparent from the foregoing that I have provided a new and novel device for use in combination with electrolytic cells for picking the crust and feeding aluminum oxide as a continuous operation in a single structure. It will be understood that changes may be made in the details of construction, arrangement, and operation without departing from the spirit of the invention, especially as defined in the following claims.

I claim:

1. A device for use in the production of aluminum by electrolytic methods wherein a plurality of cells are arranged in a housing wherein a crust forms on the surface of the baths in normal operation, said device comprising means for piercing the crust during feeding of aluminum oxide to various ones of the cell baths and to various portions of each cell bath, said means comprising a pneumatic pick, a feed housing fastened to said pick to form a part thereof and adapted to receive aluminum oxide, the outlet for said housing being directed whereby the aluminum oxide therein will be fed to the area of said crust which is broken by said pick, means for feeding aluminum oxide to said housing, means for releasing aluminum oxide from said housing through said outlet into the opening previously formed by the pick, said last mentioned means being operative to release said oxide as soon as said opening is formed, means for moving the pick and housing together into various positions above the cell baths, means for controlling the feed of aluminum oxide into and out of the housing and for controlling the operation of the pneumatic pick, and including a support in the form of an arm mounted for linear movement in one direction relative to the cell baths and for pivotal movement about an arc axis aligned with the center line of the line of cell cell baths, means for supporting the pneumatic pick and housing from said arm, including a control platform integral with and adjacent the pneumatic pick and feed housing and shiftable therewith.

2. A device as claimed in claim 1 which includes a vertically disposed bracket and in which the arm is mounted for linear and pivotal movement from the end of said bracket.

3. A device as claimed in claim 2 which includes means mounting the bracket for relative linear displacement along a line parallel with the line of cell baths.

4. A device as claimed in claim 3 which includes means for guiding the bracket during linear movement including a support in the form of an arm mounted for linear movement in one direction relative to the cell baths and for pivotal movement about a vertical axis aligned with the center line of the line of cell baths, means for supporting the pneumatic pick and housing from said arm, and including a control platform integral with and adjacent the pneumatic pick and feed housing and shiftable therewith.

5. A device as claimed in claim 1 which includes semi-elastic interconnecting means between the housing and the pneumatic pick.

6. A device as claimed in claim 2 which includes a hopper for aluminum oxide mounted on the bracket for movement therewith and in operative connection between the hopper and the housing for the aluminum oxide for transmittal of a dosage of aluminum oxide from the hopper to the housing.

7. A device for use in the production of aluminum by electrolytic methods wherein a plurality of cells are arranged in a housing and wherein a crust forms on the cell baths in normal operation, said device comprising means for piercing the crust during feeding of aluminum oxide to various ones of the cell baths and to various portions of each cell bath, said means comprising a pneumatic pick, a feed housing fastened to said pick to form a part thereof and adapted to receive aluminum oxide, the outlet for said housing being directed whereby the aluminum oxide therein will be fed to the area of said crust which is broken by said pick, means for feeding aluminum oxide to said housing, means for releasing aluminum oxide from said housing through said outlet into the opening previously formed by the pick, said last mentioned means being operative to release said oxide as soon as said opening is formed, means for moving the pick and housing together into various positions above the cell baths, means for controlling the feed of aluminum oxide into and out of the housing and for controlling the operation of the pneumatic pick, and including a support in the form of an arm mounted for linear movement in one direction relative to the cell baths and for pivotal movement about an arc axis aligned with the center line of the line of cell cell baths, means for supporting the pneumatic pick and housing from said arm, including a vertically disposed bracket mounting said arm for linear and pivotal movement and shelfed to fixed position with the floor, a track on said floor and a first roller mounted on the bottom of said bracket engaging said track, a roller supporting member, a second roller mounted on said supporting member for engaging said rail, resilient means interconnecting said supporting member and the top of said bracket thereby permitting relative vertical movement of said supporting member and said bracket, and further connecting means pivotally connecting said supporting member and said bracket whereby said vertical movement results in pivoting about the last mentioned connecting means.

8. A device as claimed in claim 7 wherein said last mentioned connecting means comprises a ball and socket type joint.

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