An apparatus for separating baked anodes received from a baking furnace. The apparatus includes a conveyor for moving a row of side-abutting baked anodes sequentially into alignment with an anode separating device having a separator blade extending downwardly from a support arm. The blade and support arm are mounted for movement in a direction perpendicular to the direction of travel of the row of anodes with the moveable arm being located above the anodes and the blade being positioned to pass laterally between adjacent anodes. A laterally moveable holding means is positioned to engage and hold the side of an anode laterally opposite the blade and means are provided for adjusting the location of the arm and blade in the direction of travel of the row of anodes to align the blade with a chamfered anode top face. An actuator means connected to the blade arm acts to firstly slide the blade along the chamfered edge until the blade engages an adjacent anode and to secondly move the blade inwardly between an adjacent pair of anodes and against the laterally moveable holding means thereby to separate a pair of adjacent anodes in the row.
DEVICE FOR SEPARATING BAKED ANODES

CROSS-REFERENCE TO RELATED APPLICATION

[0001] This application claims the priority right of prior Provisional Application Ser. No. 60/486,704 filed Jul. 11, 2003 by applicants herein.

BACKGROUND OF THE INVENTION

[0002] 1. Field of the Invention

[0003] This invention relates to the production of anodes for electrolytic cells and, more particularly, to a device for separating baked anodes received from a baking furnace.

[0004] 2. Background Art

[0005] Aluminum is produced in a Hall-Heroult cell by electrolytic reduction of alumina in a cryolite electrolyte. An electric current is passed through the electrolyte from an anode to a cathode. During this process the anodes are consumed and must be replaced on a regular basis. As a consequence, an aluminum production plant normally also includes a facility for producing anodes.

[0006] A typical anode is formed by compacting a calcined petroleum coke aggregate and a pitch binder into a self-supporting block which is subsequently baked in a large ring furnace. The baking may continue for several days at temperatures as high as 1300°C. The anodes have a generally orthogonal shape with rectangular sidewalls, top face and bottom face, with the top face having chamfered edges. Two or three holes extend into the top face for attaching the yoke of an anode support rod. These anodes typically have a greater length than height and for baking are stood on end and arranged in rows containing several anodes, with side walls abutting and the top faces (now on the side) alternating side to side. A row of baked anodes is lifted from the ring furnace and transported to a facility for rotating each anode in a row from standing on end to sitting with its top wall facing up for attachment of the support rod. Baked anodes are structurally rather fragile and must be handled with some care. In addition, it has been found that abutting anodes in a row of baked anodes are sometimes partially fused together, resulting in damage to an anode if the rotating action is started while abutting anodes are still partially fused. A device is known for rotating anodes that includes a conveyor for moving a row of baked anodes and a rotatable assembly with an anode-receiving cavity for rotating each anode in a row in sequence. It has been a standard procedure in the industry to stop the anode rotation device when fused-together anodes are detected and for a workman to manually separate the anodes using a hammer and chisel. This is a very time consuming and wasteful procedure, as it may still damage an anode such that it cannot be used.

SUMMARY OF THE INVENTION

[0007] It is an object of this invention to provide an automated system for separation abutting anodes in advance an anode rotating station.

[0008] In one aspect, the present invention relates to a device for separating fused-together baked anodes of a type which are generally orthogonal with rectangular side walls, a top face and a bottom face, with the top face having chamfered edges. A plurality of these baked anodes are received from a baking furnace arranged in rows, standing on end with sidewalls abutting and the top faces sequentially alternating side-to-side.

[0009] The separating device includes a knife or blade mounted on an arm for travel in a direction perpendicular to the direction of travel of the anodes. The blade is adapted to be positioned adjacent a top face beveled edge and to slide inwardly along the beveled edge until it abuts the bottom face of the next anode. At this point the blade is aligned with the interface between abutting anodes. A moveable abutment wall is adapted to engage and hold against lateral movement the face of an anode being separated that is opposite the location of the knife. The blade is further adapted to be moved inwardly into the interface between adjacent anodes and against the resistance of the moveable abutment and thereby separate an adjacent pair of anodes.

[0010] In another aspect, the invention relates to a method for separating baked anodes received in aligned rows from a baking furnace. The anodes are generally orthogonal with rectangular sidewalls, top face and bottom face, with the top face having chamfered edges. The anodes are arranged in rows sitting on ends thereof with sidewalls abutting and top faces alternating side-to-side.

[0011] The method comprises the steps of moving a row of baked anodes as described above along a conveyor and stopping the movement when the first anode in the row is aligned with an anode separation device. A blade adapted for movement perpendicular to the direction of movement of the row of anodes is positioned adjacent an anode top face chamfered edge and is slid along the chamfered edge until it abuts the bottom face of the next anode, at which point it is aligned with the interface between the anodes. With a moveable abutment wall being held against a face of the anode opposite the blade to prevent any lateral movement, the blade is moved inwardly into the interface between adjacent anodes and against the resistance of the abutment to thereby separate an adjacent pair of anodes.

[0012] In the above description, the terms “top face” and “bottom face” refer to the normal position of the anodes when in use. When the baked anodes are sitting on end, of course the “top” and “bottom” appear at the sides. The top face of each anode has two or three inwardly extending holes for receiving pins extending from a yoke of an anode support rod.

[0013] A sensor, e.g. a probe, detects the presence of a hole in a passing anode thereby indicating a top face. Based on whether or not a hole {and thus a top face} is detected, the blade location is adjusted so that it commences its inward movement when aligned with an anode top face chamfered edge.

[0014] The blade preferably extends downwardly from a reciprocating arm that extends horizontally above and perpendicular to the direction of travel of the row of anodes. This arm is supported by an assembly on the side of the row of anodes opposite to the blade. The support assembly also includes an abutment face for engaging the side of an anode opposite to the blade. The blade arm is connected to a pivot distal from the abutment face that permits a short horizontal swinging action of the arm and blade for locating the blade in alignment with a chamfered edge of an anode.
BRIEF DESCRIPTION OF THE DRAWINGS

Fig. 1 is an elevation view of the general layout showing the invention within a factory;

Fig. 2 is a perspective view of the anode separator assembly;

Fig. 3 is a side elevation of the anode separator with anodes in place;

Fig. 4 is a plan view of the assembly of Fig. 3;

Fig. 5 is an end elevation of the anode separator;

Fig. 6 is a vertical sectional view through the anode separator;

Fig. 7 is a side elevation of the anode separator with the separator blade moved into contact with anodes; and

Fig. 8 is a side elevation of the anode separator with both the separator blade and an abutment in contact with the anodes.

DETAILED DESCRIPTION OF THE INVENTION

As shown in Fig. 1, the anode separator of this invention can conveniently be used in an existing part of an anode production plant. Here a set of baked anodes 11 received from a ring furnace are placed on a roller conveyor 10 at one end of an existing anode rotating device (not shown) for rotating the anodes on an end position as shown to their normal orientation for installation of top support rods. The individual anodes are shown as 11A, 11B, 11C, etc. This existing assembly also includes a pusher assembly 12 for moving the row of anodes stepwise along the conveyor 10.

The anode separator of the invention is shown generally at 13 and includes a support structure having vertical posts 14 and a top frame 15. A pair of supports 17 extend down from frame 15 and serve to carry a pair of tracks 16. A moveable carriage 18 is supported for travel on the tracks by way of wheels 19 (see Fig. 2).

The carriage 18 includes side plates 20 to which the wheels 19 are attached, a top cross brace 21 (see Figs. 5 and 6) and a bottom wall 22. It also includes front end plates 23 and a central cross support 24. Mounted within the carriage is a square box beam 25 having attached to the free end thereof a downwardly extending blade 26 for separating the anodes. The beam 25 rides on the central cross support 24 and includes a bottom pad 27 that sits on ball bed of rolling balls 28.

The inner end of beam 25 connects to a pivot post 30 that allows some lateral movement of the outer (free) end of the beam. This lateral movement is controlled by means of a pair of air cylinders 34 located on each side of beam 25. A hydraulic cylinder 31 is also mounted within the carriage with a pivotal connection 32 at one end to end wall 23 and the other end 33 attached to pivot post 30. The cylinder 31 serves to move the beam 25 backward and forward within the carriage 18.

An individual baked anode 11A can be seen in some detail in Fig. 3 and a pair of adjacent anodes 11A and 11B can be seen in Fig. 4, here sitting on one end. The individual anodes include end walls 35, side walls 36, a bottom wall 37 and a top wall 38. The top wall 38 in this embodiment includes three hole 40 extending into the top wall for receiving a top support rod. The top wall 38 also has deeply chamfered edges 41. As can be seen from Figs. 1 and 4, the anodes arrive from the ring furnace in rows of anodes standing on end with the top walls 38 along each side of the row alternating with bottom walls 37.

As a row of baked anodes moves along the conveyor 10 they are aligned laterally by a pair of air cylinder actuated plates 42 on each side of the row as seen in Figs. 2 and 3. Also at one side of conveyor 10 is an air cylinder actuated probe 43 that extends forwardly as shown in Fig. 3 when it engages an anode hole 40 and thus a top wall 38. Whether or not the probe 43 detects an anode top wall 38 determines where the beam 25 and blade 26 are positioned by the cylinders 34.

The row of baked anodes is moved along the conveyor 10 until the forward anode 11A in the row engages a stop at which point the pusher mechanism 12 disengages. The anodes are now in the position shown in Figs. 4 and 5 with the blade 26 adjacent the chamfered edge 41 of anode top wall 38. Next the beam 25 and blade 26 move inwardly by a first action of hydraulic cylinder 31 to the position shown in Fig. 7. The carriage next also moves inwardly by a second action of cylinder 31 such that front end wall 23 abuts the anodes as shown in Fig. 8. At this point a pair of adjacent anodes 11A, 11B is being held at one side by blade 26 and at the other side by carriage end wall 23. Hydraulic cylinder 31 is now further actuated to pull the blade 26 inwardly between an adjacent pair of anodes and against the resistance of carriage end wall 23, and thereby separating a pair of baked anodes. Even when there is a considerable amount of fusion at the interface between an adjacent pair of anodes, a clean separation is achieved without damage to either anode.

What we claims is:

1. An apparatus for separating baked anodes received from a baking furnace, said baked anodes being of a type which are generally orthogonal with rectangular side walls, top face and bottom face, with said top face having chamfered edges, and being arranged in rows of anodes sitting on ends thereof with said side walls abutting and said top faces alternating side-to-side,

said apparatus comprising a conveyor for moving a row of said side-abutting baked anodes sequentially into alignment with an anode separating device having a separator blade extending downwardly from a support arm, said blade and support arm being mounted for movement in a direction perpendicular to the direction of travel of the row of anodes with the moveable arm being located above the anodes and the blade being positioned to pass laterally between adjacent anodes, laterally moveable holding means adapted to engage and hold the side of an anode laterally opposite the blade, means for adjusting the location of the arm and blade in the direction of travel of the row of anodes to align the blade with a chamfered anode top face, actuator means connected to the blade to control the blade to slide over the anode to adjust the anode to align the blade with the anode top face, said actuator means connected to the blade to control the blade to slide over the anode to align the blade with the anode top face.
against said laterally moveable holding means thereby to separate a pair of adjacent anodes in the row.

2. The apparatus of claim 1 wherein the laterally moveable holding means is an end face of a laterally moveable carriage which supports said blade arm and actuator means.

3. The apparatus of claim 2 wherein the blade arm is pivotally mounted on the carriage at an end distal from the blade to permit movement of the blade in the direction of travel of the anode row.

4. The apparatus of claim 3 that comprises an air cylinder on each side of said blade arm for moving the arm on a forward or backward direction.

5. The apparatus of claim 4 wherein the actuator for moving the blade arm perpendicular to the row of anodes is a hydraulic cylinder.

6. The apparatus of claim 4 that includes a sensor located on one side of the row of anodes and being adapted to detect mounting holes in anode top faces and in consequence activate said air cylinders on each side of the blade arm.

7. A method for separating baked anodes received from a baking furnace, said baked anodes being generally orthogonal with rectangular side walls, top face and bottom face, with said top face having chamfered edges, and being arranged in rows of anodes sitting on ends thereof with said side walls abutting and said top faces alternating side-to-side,

   said method comprising the steps of moving a row of said anodes sitting on ends thereof along a conveyor and stopping the movement when the first anode of said row of anodes is aligned with a separating device having a laterally moveable holding means for holding one side of said first anode and a separator blade moveable in a direction perpendicular to the direction of travel of the row of anodes and toward said holding means and being adjustable in the direction of travel of the row of anodes, wherein the separating steps comprise moving the blade inwardly as a chamfered edge of a said top face until it engages the adjacent abutting anode, stopping the motion of the blade, laterally moving said holding means to engage a side of the anode opposite the separator blade and then moving the separator blade toward the holding means and between the abutting pair of anodes thereby separating said first anode from the abutting anode.

8. The method of claim 7 wherein the holding means and separator blade are both retracted after said first anode is separated.

9. The method of claim 7 wherein the blade is mounted on the free end of a support arm for movement perpendicular to the direction of travel of the anode rows and is moved into and out of engagement with the anodes by means of a hydraulic cylinder attached to the support arm.

10. The method of claim 9 wherein a pair of actuators are mounted on each side of said telescopic arm and move the free end of the arm and separator blade backward and forward in the direction of travel of the anodes for aligning the blade with a said chamfered edge.

11. The method of claim 10 wherein a sensor is located on one side of the row of anodes, said sensor detecting mounting holes in an anode top face thereby indicating the orientation of each anode, said sensor in consequence directing said pair of actuators to move the support arm and blade into alignment with an anode top face chamfered edge.

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