Aug. 3, 1965 I. G. PICKERING ETAL 3,198,669

METHOD AND APPARATUS FOR HANDLING ANODES

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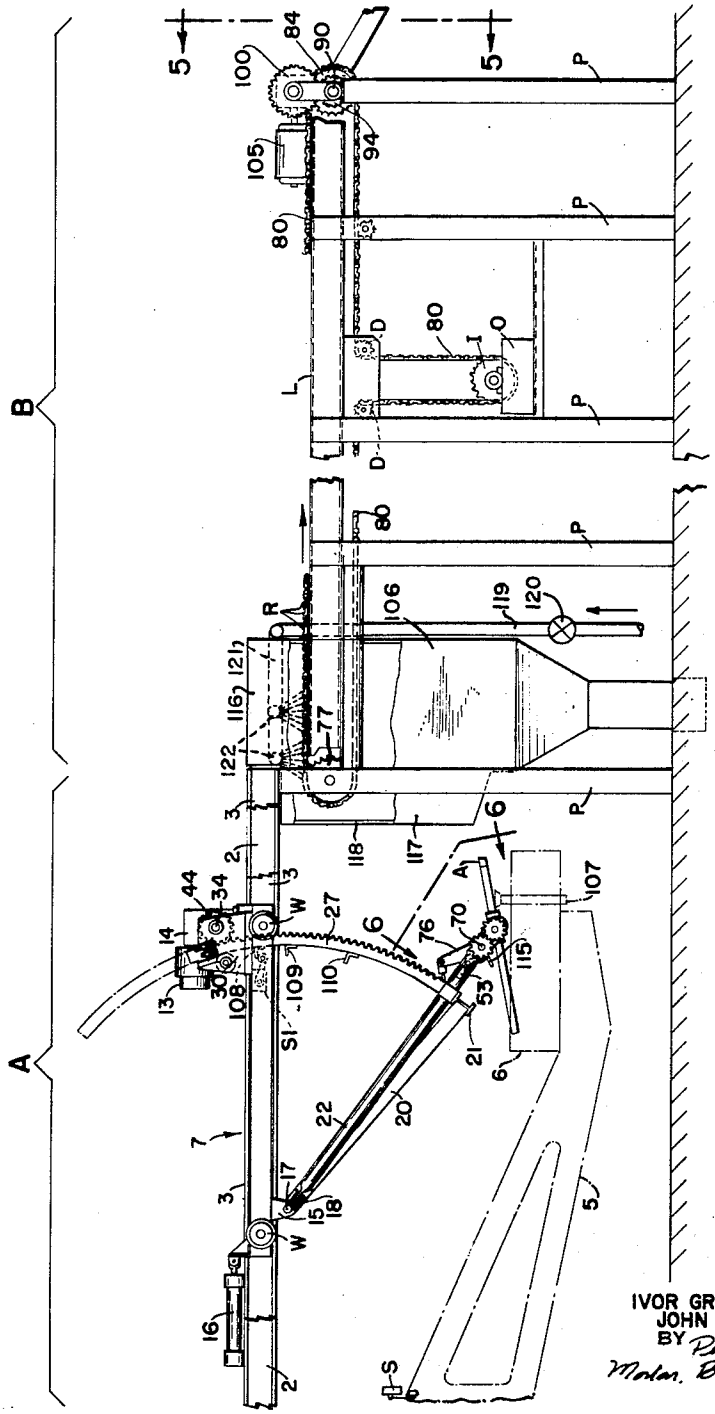


FIG. 1

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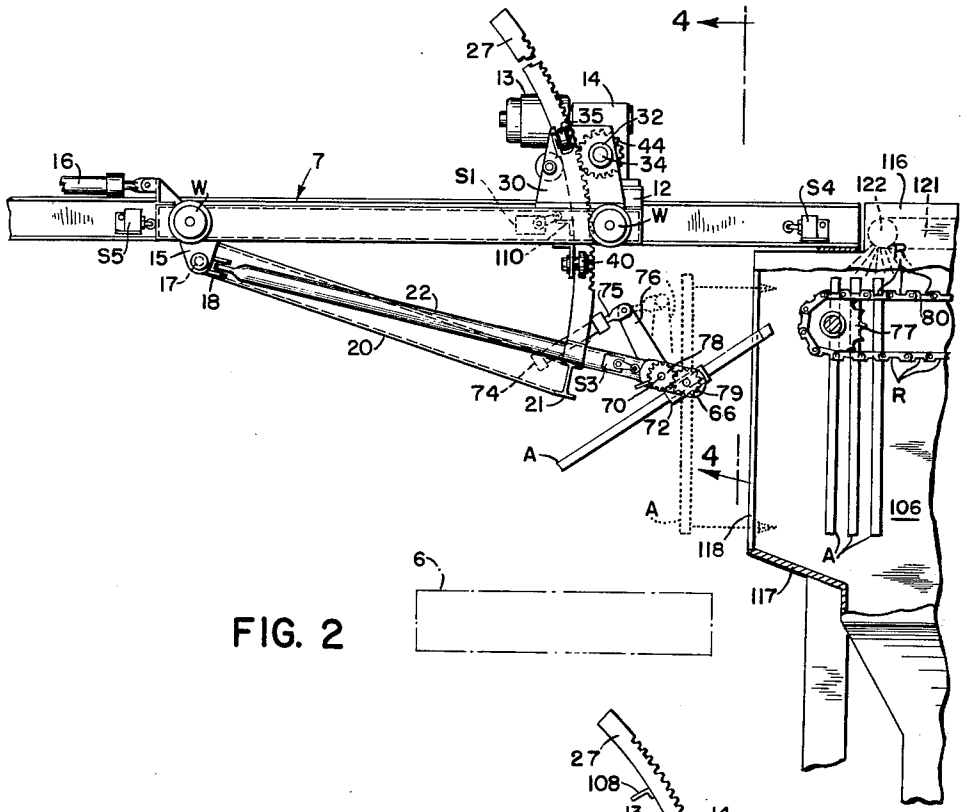


FIG. 2

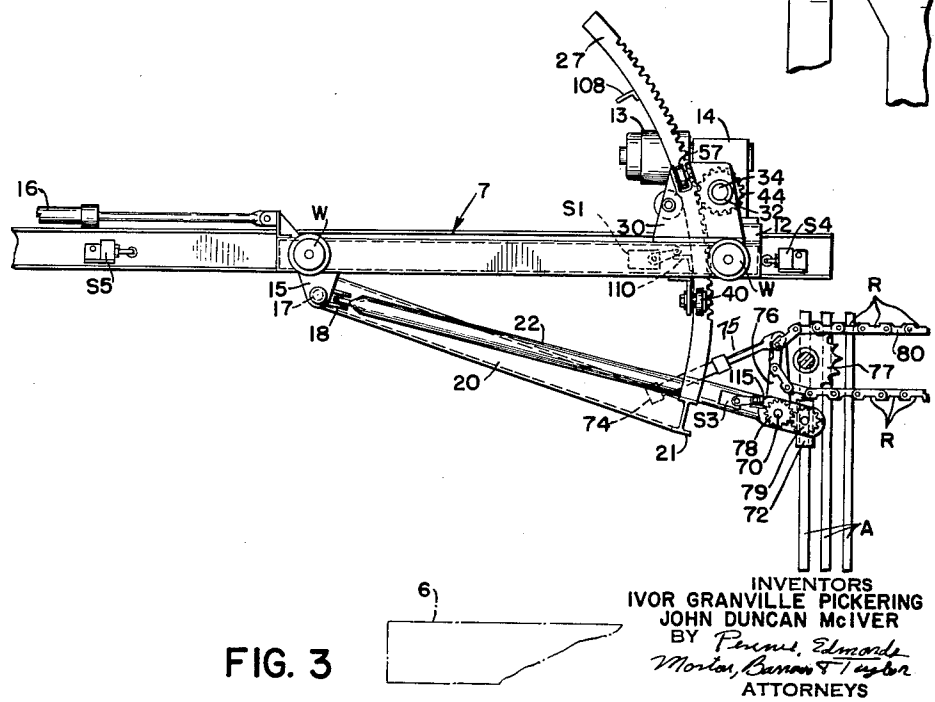


FIG. 3

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FIG. 4

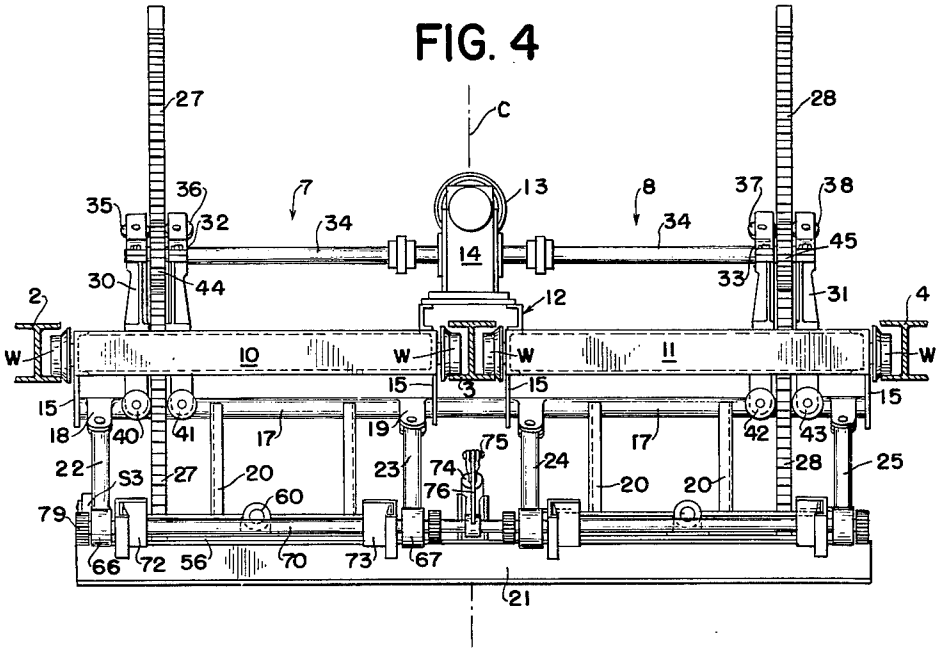
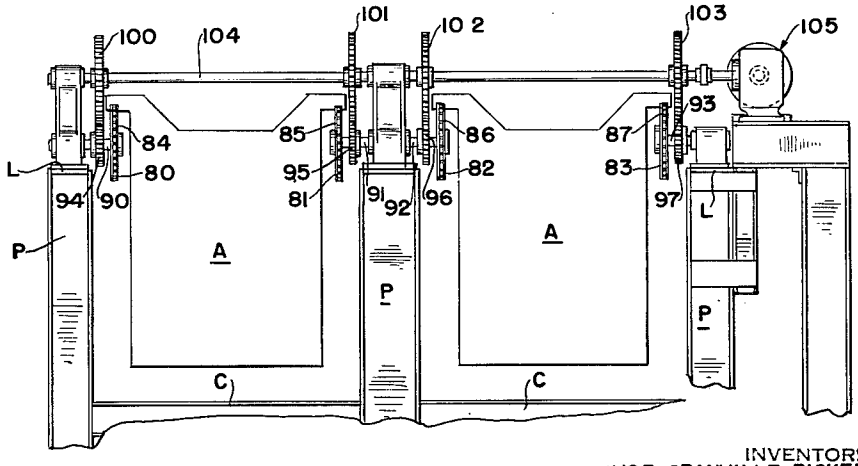


FIG. 5



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FIG. 6

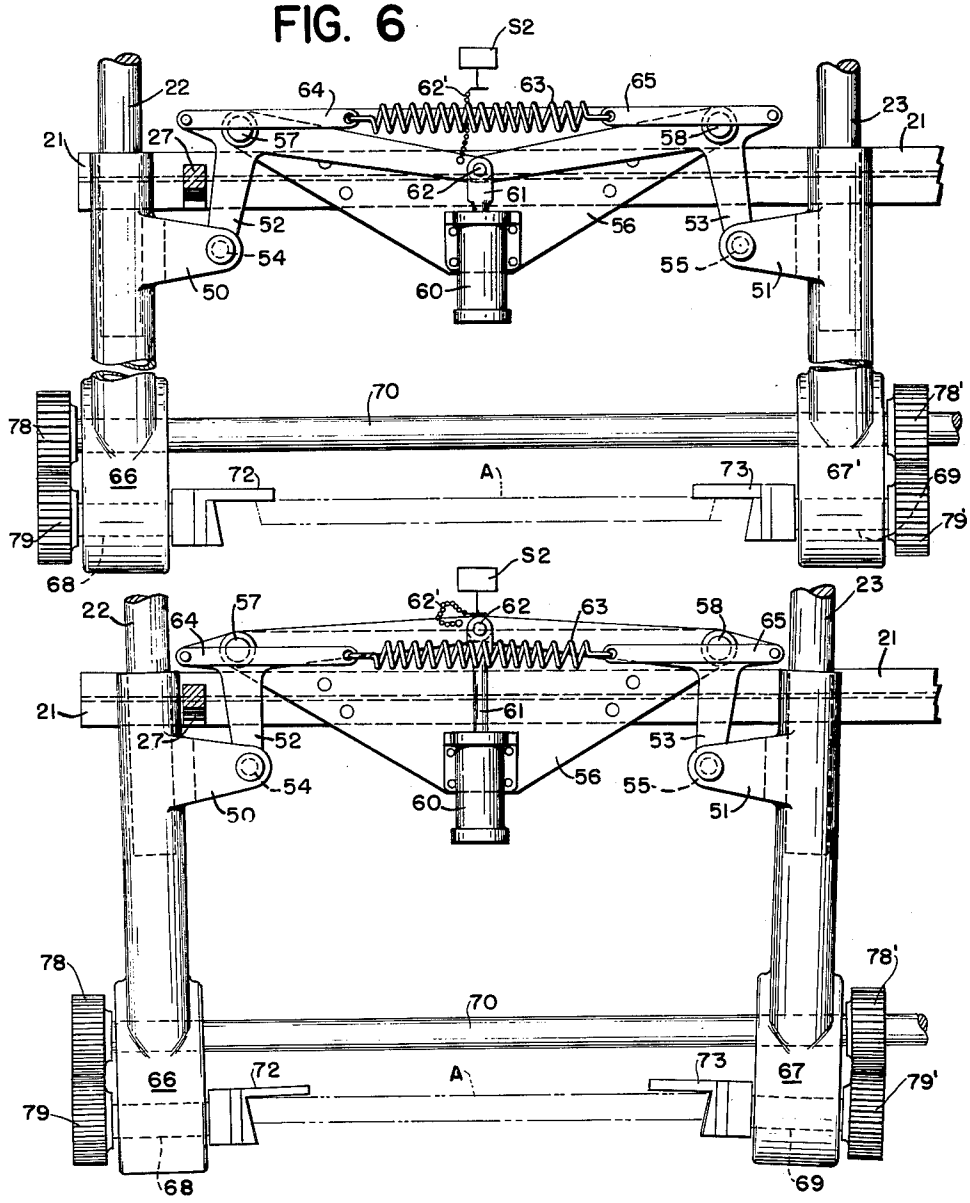


FIG. 7

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3,198,669
METHOD AND APPARATUS FOR HANDLING ANODES

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Filed Sept. 2, 1964, Ser. No. 393,829
4 Claims. (Cl. 148—1)

This application is a continuation-in-part of prior application Serial No. 133,988, filed August 25, 1961, now abandoned.

This invention relates to the removal of newly cast copper anodes from the molds of the casting wheel and placing them in vertical position on a conveyor having suitably spaced endless chains with the anodes suspended thereon by the anode lugs or ears which later on serve a similar purpose in supporting the anodes in electrolytic cells.

When the anodes are newly cast the anode lugs or electrode contacts are not completely solidified so that the handling of the anodes by these lugs without deforming them presents a problem. This is particularly apparent when it is considered that the entire weight of the anodes is carried by the lugs and the dimensions and alignment of these lugs are critical in order that the anodes may be properly received within the electrolytic cells.

The purpose of the present invention is to convey the hot, newly cast anodes from the casting wheel and molds, without touching or deforming the critical anode lugs, and while depositing the anodes on properly spaced conveyor chains applying a cooling water spray to insure rapid and complete solidification of the anode lugs so they will have the required strength to support the anode. The cooling water spray is applied to the lugs while the anode is being supported by the take-off mechanism and before the full weight of the anode is supported on the conveyor by the lugs. In addition the invention aims to move the anodes directly from the take-off mechanism to the conveyor, thus avoiding raising them over the top of a tank of cooling water and then lowering them into the tank.

The anode take-off mechanism removes the anodes one at a time, or a pair of side-by-side anodes at the same time, turns them from horizontal to upright position, raising them sufficiently above the casting wheel to place their lugs approximately in horizontal alignment with the conveyor chains, and then advances the anode, or anodes, directly to the conveyor chains as they round the supporting sprockets which are located close to the casting wheel. The conveyor passes through a cooling chamber which has an entrance opening slightly larger than the dimensions of the electrodes and through which the electrodes pass to reach the conveyor chains.

Within the hood of the cooling chamber crosswise spray pipes are arranged which produce a cooling water spray across the entire width of the anodes on the conveyor. A part of the cooling water spray from the first spray pipe drenches the lugs of the anode which is approaching close to the conveyor as well as the lugs of anodes which have already been received and supported on the two conveyor chains. The spray is prevented by the anodes themselves from passing through the entrance to the cooling chamber and reaching the molds on the casting wheel, inasmuch as the mold pockets must be protected from being flooded with water from the cooling spray.

These and other novel features of the invention will be better understood after considering the following discussion and accompanying drawings, in which

FIG. 1 is a side view of an arrangement of apparatus embodying the invention;

FIG. 2 is an enlarged side view of a part of the apparatus of FIG. 1, showing a different position of the take-off mechanism;

FIG. 3 is a view similar to FIG. 2, showing another position of the take-off mechanism;

FIG. 4 is a view taken at 4—4 of FIG. 2;

FIG. 5 is an end view at 5—5 of FIG. 1;

FIG. 6 is an enlarged view of the anode gripper mechanism of FIG. 1 taken along line 6—6 of FIG. 1; and

FIG. 7 shows the anode gripper mechanism of FIG. 6 in the closed or anode engaging position;

The apparatus illustrated in FIG. 1 comprises two main parts: the take-off mechanism A and the conveyor or anode receiving mechanism B. The take-off part A comprises a supporting frame structure consisting of upright steel posts P which carry horizontal I-beams 2, 3 and 4 in spanning position over the anode casting wheel 5 which carries a plurality of peripheral molds 6 (only a segment of the casting wheel is shown). The take-off carriage consists of two identical carriage parts 7 and 8 (FIG. 4) consisting of platforms 10 nad 11 which are spaced apart at their centers and are bridge together by the structure 12. The platforms have shafts mounted therein for the wheels W which ride on the flanges of the beams 2, 3 and 4. It is to be understood that there are four wheels at the rear as at the front. The structure 12 forms a platform for the motor 13 and gear box 14.

The carriages 7 and 8 are reciprocated on the beams 2, 3 and 4 by the hydraulic piston in the cylinder 16. The cylinder is controlled to move the carriages to the rearward position as shown in FIGS. 1 and 2 or to the forward position such as shown in FIG. 3.

There are two depending bearing brackets 15 near the rear of the carriage in which the transverse shaft 17 is mounted. This shaft has secured thereto four beams 20 which are secured to a front beam 21 in a manner similar to that shown in FIGS. 1 and 4. This shaft carries four pivotally mounted arms 22, 23, 24 and 25 which rest at the front on the beam 21.

With reference to FIG. 4, it will be apparent that there are two identical anode take-off mechanisms, one for each carriage part located on each side of the center line C. These identical mechanisms function simultaneously to pick up two anodes from the casting wheel at the same time. Accordingly, it will be sufficient merely to describe in detail one of these take-off mechanisms.

As best shown in FIGS. 1, 4 and 6, the two arms 22 and 23 are pivotally attached to the extensions 18 and 19 on the shaft 17 and can swing towards and away from each other while resting at their forward ends on the beam 21. Beam 21 supports the forward portion of the anode gripping apparatus shown in FIGS. 4, 6 and 7 and provides a mounting thereon for the lower ends of two arcuate racks 27 and 28 and these racks provide a means for moving the beam 21 and all of the associated elements thereon in an upward and downward movement.

The front top-portion of the carriage 7 has bearing bases 30 and 31 secured thereon in which are mounted bearings 32 and 33 for the shaft 34, which is driven by the motor 13 and gear box 14. The bearing bases also have mounted thereon for each of the arcuate racks two sets of guide rollers 35, 36, 37 and 38. There are depending from the under surface of carriage 7 and secured thereto two additional sets of guide rollers 40, 41, 42 and 43. Each arcuate rack is accordingly provided with two sets of spaced guide rollers for directing its upward and downward movement.

The shaft 34 has two pinion gears 44 and 45 which are operated in both directions by the motor 13 and gear box 14 to elevate or depress the gear racks and accordingly

raise and lower the beam 21 and its associated equipment.

As best shown in FIGS. 6 and 7 the preferred gripping and release means has inwardly extending brackets 50 and 51 on the arms 22 and 23 to which the toggle members 52 and 53 are pivotally connected by pins 54 and 55. A triangular supporting plate 56 is secured to the beam 21. The toggles are also pivotally connected to this plate by the pins 57 and 58. The cylinder 60 which is attached to the plate 56 has its piston rod 61 attached through the pin 62 to the ends of the toggles 52 and 53. A strong spring 63 is connected by links 64 and 65 to the toggles.

The ends of the arms 22 and 23 have attached bearing blocks 66 and 67 in which the shafts 68, 69 and 70 are mounted. The shafts 68 and 69 carry the anode gripper members 72 and 73.

The anode toggle-gripping means of FIGS. 1 to 7 is operated by the electrical control apparatus hereinafter described by applying fluid under pressure to cylinder 60. This pushes the toggles upward from the position of FIG. 6, the open expanded position of the grippers 72 and 73, to the contracted or closed position of FIG. 7, in which position the grippers engage the anode A shown in broken lines. When the pressure of the fluid on the cylinder 60 is vented to the opposite side of the piston on rod 61 the piston assisted by the spring 63 pulls the toggles inwardly spreading the arms 22 and 23, together with the attached grippers, releasing the anode.

The hydraulic cylinder 74 (FIGS. 2, 3 and 4) mounted on the beam 21 is connected through rod 75 and arm 76 to the shaft 70 which carries gear 78 at one end which meshes with gear 79 on the shaft 68. By means of the switching means hereinafter described fluid under pressure is supplied to either side of the piston of cylinder 74 to turn shaft 70 and through the gears 78 and 79 and also the shafts 68 and 69 to turn the gripper elements and the engaged anode A. By means of this mechanism the anode can be gripped as shown in FIG. 1, lifted and swung as shown in FIG. 2, and further lifted and turned and deposited on the conveyor as shown in FIG. 3.

The conveyor portion of the apparatus B is mounted on a supporting structure consisting of a plurality of upright posts P and longitudinal beams L. The posts are held in rigid position by cross beams C (FIG. 5). These beams L provide supporting tracks for the two pairs of endless conveyor chains 80, 81, 82 and 83. These chains are each mounted at one end (the left as shown in FIG. 1) on a freely rotatable chain sprocket 77 and on the opposite end on the chain sprockets 84, 85, 86 and 87 which are mounted on and keyed to drive shafts 90, 91, 92 and 93 respectively. These shafts are secured to gears 94, 95, 96 and 97 which mesh with gears 100, 101, 102 and 103 on shaft 104.

The shaft 104 is connected to and is driven by a standard motor-driven Ferguson unit 105 which drives and stops the shaft at controlled intervals as will be described hereinafter. The chains also pass over the direction sprockets D and slidable idler sprockets I which can be moved upward and downward to maintain proper tension in the chains. The chains also pass through oil pans O located below the idler sprockets I.

The links of the chains are constructed to have recesses R into which the anode lugs or ears are placed to support the anodes and are of such length that the spaces between the recesses secure the anodes in proper spaced relation to each other, for example about 4⅛ inches apart. Each of the chains is moved simultaneously in the direction of the arrow in increments equal to the length of the links by means of the Ferguson unit.

At the entering end of the conveyor (shown at the left in FIGS. 1 and 2) there is a cooling chamber 106 having a hood 116 extending above the conveyor chains 80 and 81 (referring to a single conveyor). It will be understood that the arrangement is duplicated for two conveyors and the total width apparatus as shown in FIGS. 4 and 5.

Chamber 106 has an extension 117 at its left or entering side which projects beyond the sprockets 77 at the left end of the conveyor chains so that the anodes may enter the cooling chamber as soon as possible after being removed from the mold trays 6. An opening 118 is provided in extension 117 which is just enough larger in its dimensions than the anodes to admit them after they are in vertical position.

Cooling water supply line 119 having a control valve 120 delivers cooling water under high pressure to a header pipe 121 within hood 116. Header 121 branches into each of two large (2½") spray pipes 122 which extend crosswise of chamber 106, crossing the entire width of the anodes A. The spray pipe 122 which is nearest entrance 118 is immediately above and slightly behind or to the right of chain sprockets 77. Spray pipes 122 deliver the sprays indicated by the dotted lines in FIGS. 1 and 2 throughout the width of the anodes carried forward to the right by the conveyor chains 80 and 81.

The apparatus includes an hydraulic fluid system, such as one operated by compressed air or oil under pressure, which supplies the air through connecting pipes and solenoid valves to the cylinders 16, 74 and 60 of the apparatus of FIG. 1. These valves are constructed and arranged with solenoid valves (not shown) to admit air under pressure to pistons of the cylinders to move them in the directions required, and to release the air, and admit air on the opposite side of the piston to effect reversal of the pistons.

The operation of the apparatus of FIGS. 1 to 7 will now be described in connection with various switches by means of which the operation is fully automatic.

The casting wheel is turned under the control of an operator in the casting wheel cab (not shown). When the wheel reaches a position, "on spot," for the removal of the anodes a magnetic switch S on the wheel hub (FIG. 1) is tripped and this signals to the operator to stop the casting wheel. At this stop position the casting wheel is ready to receive copper in two molds simultaneously and it is also in position for removal of two of the previously cast anodes which have solidified. If the wheel is on the exact spot for anode removal a green light shows in the wheel cab; if not, an amber light shows and this indicates that the wheel is not in proper position and must be adjusted. When the proper adjustment has been reached by small increments of movement the green light turns on. The magnetic switch on the hub of the casting wheel locks the wheel drive to hold the anodes and molds in fixed position under the takeoff mechanism. When this green light, "on spot," position has been reached the anodes A to be lifted are pushed upward out of the mold by the device 107, as shown in FIG. 1.

Magnetic switch S is also in series with motor 13 which drives the racks 27 and 28 downward from the upper position to the lower position as shown in FIG. 1. The limit switch S1 on beam 2 has three switch positions which are actuated by three projecting pins 108, 109 and 110 on the rack 27. As the mechanism approaches its lower position the pin 108 engages one component of switch S1 to stop motor 13 at the position of FIG. 1. This switch is connected to a solenoid valve of an air valve (not shown) to actuate the air cylinder 60 (FIGS. 6 and 7) to close the arms 22 and 23 and cause the gripping members 72 and 73 to engage the anode. In the closed position of FIG. 6, the switch S2 (FIGS. 6 and 7) is closed and this switch which is in circuit with motor 13 turns the motor 13 on to lift the arm assemblies with their engaged anodes from the position of FIG. 1 to the position of FIG. 2.

As this upper position is reached the pin 110 engages switch S1 and stops motor 13 at the upper position. Switch S1 is also in series with a time delay means of a solenoid valve (not shown) which supplies air to the tilting cylinder 74. This causes the rod 75 and arm 76 to turn shaft 70, gears 78 and 79 and the anode grippers 72 and 73 to turn the anode to the broken line position of FIG.

2. As the cylinder 74 turns shaft 70 and anode grippers 72 and 73, the pin 115 on shaft 70 (FIG. 3) engages the flag of switch S3 which closes the said air valve for cylinder 74 and stops the tilting of the anode, leaving it in the vertical position.

This switch is also in series with a solenoid valve (not shown) which admits air under pressure to cylinder 16 which pushes the carriage to the right (FIG. 2). Thre anode, or anodes, enter the cooling water spray chamber extension 117 in vertical position and from the time they pass through entrance opening 118 they are subjected to the cooling action within the chamber. When the carriage advances to the right, it strikes switch S4 on the beam 2 which closes the solenoid valve of cylinder 16 and stops the carriage with the anode in the spot position over the carrier chains 80, 81, 82 and 83 (FIG. 3). During the latter part of this movement and while the anode is being deposited on the chains the upper parts of the anode including the lugs are drenched with cooling water from the nearest spray pipe 122 so that by the time the anode reaches the position of FIG. 3 and is released onto the chains its lugs are completely solidified and have the necessary strength to support the anode. Switch S4 is also connected to the solenoid valve controlling cylinder 60 (FIGS. 6 and 7) to cause the rod 61 to move from the position of FIG. 7 to the position of FIG. 6 and release the anode and deposit it on the chains 80, 81, 82 and 83.

Switches S4 and S2 are also connected to the Ferguson drive 105 which starts the drive when switch S4 is closed and S2 is open to advance the chains in the direction of the arrow about 4⅛ inches. The Ferguson drive has a built-in cam controlled switch which stops the motor thereof when the chains have moved precisely 4⅛ inches. The chain 62' fastened at one end to arm 52 and at the other to the flag of switch S2 pulls switch S2 to its second position which is in series with the valve of cylinder 16 to drive the carriage 7 towards the left to the position of FIG. 1 at which time the carriage strikes switch S5 (FIG. 2) which is connected to the valve of the cylinder 16 to stop the carriage. When switch S5 is closed it also is connected to the valve of cylinder 74 to move lever 76 in the opposite position to tilt the anode grippers back to the starting position of FIG. 1. When switch S5 is closed it is also connected to motor 13 to start the racks 27 and 28 moving downward to the lower or ready position of FIG. 1. As the rack moves downward it reaches a position where the pin 108 strikes the flag of switch S1 to stop the motor 13 and the downward movement of the take-off mechanism at the ready position.

We claim:

1. The method of transferring a series of copper anodes one at a time from a casting wheel and hanging them by their lugs on a horizontal chain conveyor which comprises mechanically gripping each anode, turning it to an upright position with the lugs extending upwardly, moving it directly to the chain, and while depositing the anode on the chain applying a cooling water spray to insure rapid and complete solidification of the anode lugs so that they will have the strength required to support the anode.

2. The method according to claim 1 of transferring a series of copper anodes one at a time from a casting wheel and hanging them by their lugs on a horizontal chain conveyor wherein each anode after reaching upright position is transferred horizontally as well as directly to the chain.

3. Apparatus for removing a series of anodes from a casting wheel and storing them on a conveyor which comprises a storage conveyor having its receiving end disposed at a distance above the molds of the casting wheel corresponding approximately to the height of the anodes, a cooling chamber at the entrace end of the conveyor having an entrance opening for the anodes in the wall thereof facing the casting wheels, means for successively removing anodes one at a time from the casting wheel and turning them to upright position with the lugs thereof approximately level with the conveyor and depositing them on the conveyor to be supported thereon by their lugs, and means for applying a cooling spray of water to the anodes as they are being deposited on the conveyor so as to cool and completely solidify the lug portions of the anodes before they are received on the conveyor.

4. Apparatus for removing from a casting wheel and storing copper anodes having supporting lugs which comprises a storage conveyor having its receiving end disposed at a distance above the rim of the casting wheel corresponding approximately to the height of the anodes, a cooling chamber at the entrance end of the conveyor having an entrance opening for the anodes in the wall thereof adjacent the casting wheel, means for removing from the casting wheel and turning an anode to upright position with the lugs thereof approximately level with the conveyor and depositing the anode on the conveyor to be supported thereon by the anode lugs, the side walls of the cooling chamber extending beyond the receiving end of the conveyor so as to cool and harden the lug portions of the anode before it is received on the conveyor.

No references cited.

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