Aug. 27, 1957 J. WLEÜGEL 2,804,429

ARRANGEMENT OF CONDUCTORS FOR ELECTROLYTIC FURNACES

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Fig. 2

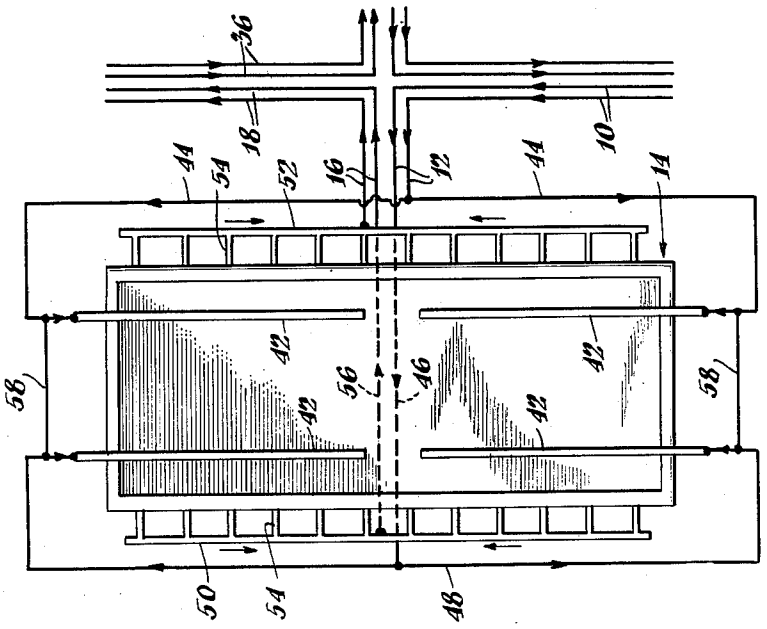
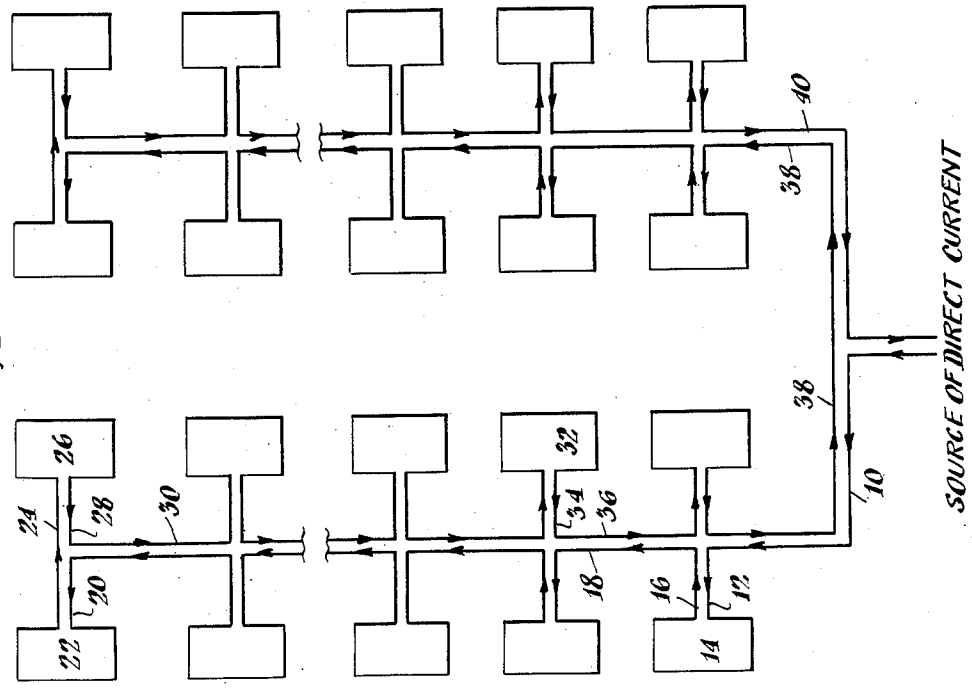


Fig. 1



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Fig. 4

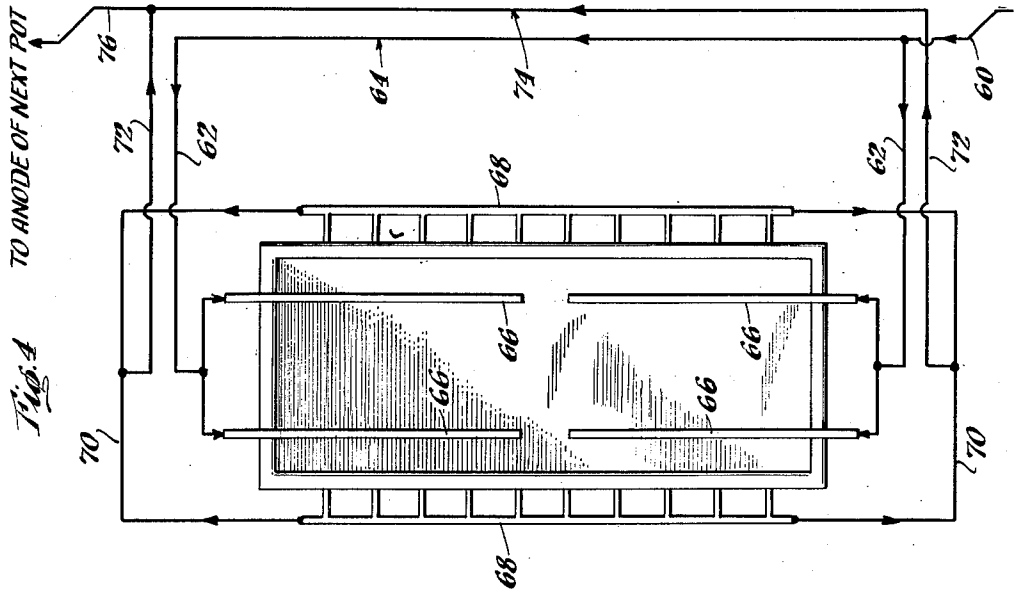
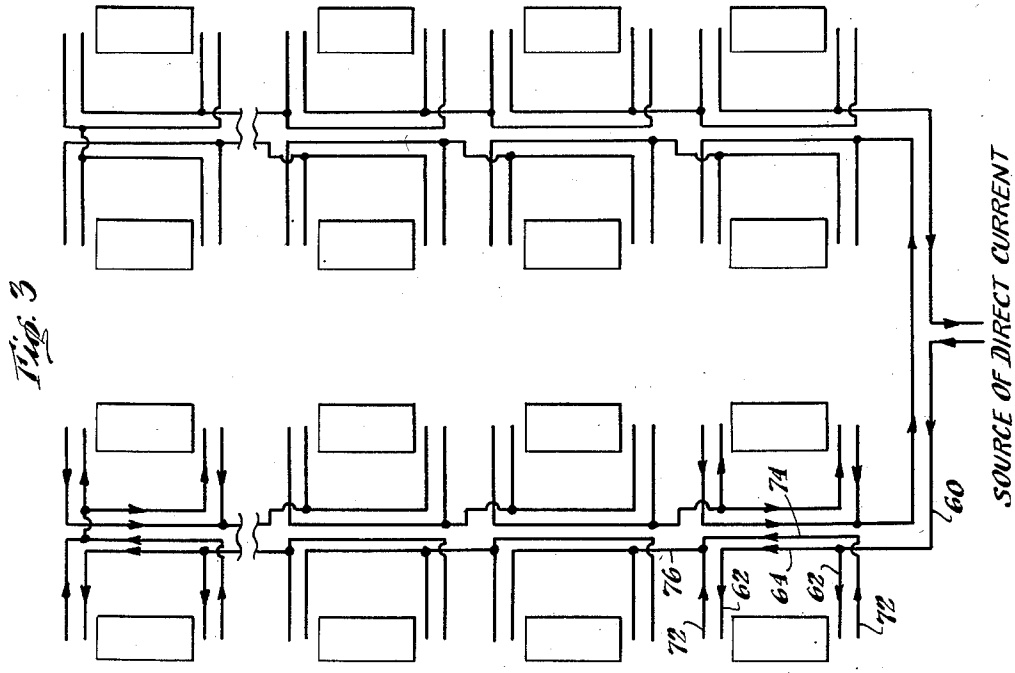


Fig. 3



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ARRANGEMENT OF CONDUCTORS FOR ELECTROLYTIC FURNACES

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Application February 1, 1954, Serial No. 407,421
Claims priority, application Norway February 5, 1953
3 Claims. (Cl. 204—244)

In aluminum plants it is customary to have the plant laid out with rows of pots running parallel to each other and with the pots in each row connected in series, that is, the cathode of one pot is connected to the anode of the next pot so that the current flows up through one line of pots and back through the next adjacent line. The amperage used in these pot lines is very high and in modern practice it may range up to 100,000 amperes. Because of this flow of current each of the furnace lines will be surrounded by a magnetic field which will influence the furnaces of the neighboring row. This field together with the horizontal electric currents in the metallic bath will produce electro-magnetic forces which may displace the metal in the baths in one or the other direction sufficiently so that the molten aluminum will have a distinctly different level within a bath. This creates great difficulties in operation and to obtain good results in an aluminum furnace installation it is very important that the magnetic fields be reduced as far as possible so that differences of level in the individual pots due to electromagnetic action are reduced to a minimum.

The present invention relates to a particular arrangement of current conductors whereby this situation is very greatly improved. The essence of this invention is that whenever possible the conductors be arranged so that the conductors are closely adjacent to each other with the current flowing in opposite directions in neighboring conductors. The closer the conductors can be placed without contact, the better the effect, but since the pot lines will be between 9 and 15 feet apart, valuable results are obtained if the conductors carrying current running in opposite directions are placed as much as two feet from each other. It must be borne in mind that the conductors for carrying currents of this amplitude must themselves involve large masses of metal, and the mechanical arrangements may necessitate a substantial spacing. However, I repeat that the spacing should be kept as small as circumstances permit.

In the accompanying drawings I show diagrammatic views illustrating the arrangements which have been found to give greatly improved results over ordinary pot line arrangements. In these drawings,

Fig. 1 is a plan view showing a general wiring arrangement of a series of four pot lines;

Fig. 2 is a view in greater detail showing the connections of Fig. 1 as made to an individual pot;

Fig. 3 shows a portion of two pot lines with a different arrangement accomplishing a similar result, and

Fig. 4 is a detailed view showing the connections to an individual pot connected in accordance with the arrangement of Fig. 3.

As shown in Fig. 1 the current flows in through the line 10, then turns at 12 and passes through the pot indicated at 14. The returning current from the pot 14 passes through the line 16 which is closely adjacent and parallel to the branch line 12 which then comes out to the central area and continues in its original direction as indicated at 18. This continues through each of the

pots in the line until the end of the line is reached. Then the current which flows through the branch line 20 passes through the pot 22 and on its return passes across through the line 24 to the pot 26. The current coming from the pot 26 will now flow back toward the original source, that is, through the branch line 28 and the main line 30 which is directly parallel and adjacent to the main line through which the current passed toward the end of the pot line. Specifically, the current which passes from the pot 32 will pass through a branch line 34 and then through the main line 36 directly parallel and closely adjacent to the main line 18. The current may then cross over through line 38 to two more pot lines and ultimately return, as through the line 40 to the generator. It will be seen that in this arrangement the lines running to each pot, as the lines 12 and 16 shown in connection with pot 14, are closely adjacent, with the current running in opposite directions, and the main lines, as for example lines 18 and 36, likewise can be placed closely adjacent with the current running in opposite directions.

The connections within the pot can also be arranged to carry out this idea. For example, in Fig. 2 the pot 14 is indicated by double lines so that it will not be confused with the electrical connections which are shown diagrammatically. It is to be borne in mind that because of the high amperage, it is customary to sub-divide the lines and in this case the lines 10 and 12 are shown double as are likewise the lines 16, 18 and 36.

In the pot the anode bus bars 42 are understood to be elevated and are connected in a usual way to the movable carbon electrode which goes down into the bath. Details of such a construction are shown, for example, in Jouannet Patent No. 2,475,452 in which the anode bus bars are designated by the numeral 22.

In Fig. 2 one branch of the line 12 leads to a central point of the furnace and is attached to a bus bar 44 which is quite close to the furnace pot. This bus bar runs along the entire side of the pot and then at the ends is carried upward to connect with two portions of the anode bus bars 42. It is to be noted that these are not continuous but are separated in the middle. Another branch of the line 12 passes under the center of the furnace as indicated at 46 and is connected to a bus bar 48 corresponding directly to the bus bar 44. The ends of the bus bar 48 likewise are connected to the two portions of the anode bars 42.

The cathode bus bars 50 and 52 run directly parallel and adjacent to the bus bars 48 and 44 and have the usual connections 54 running into the pot where they connect with the metallic bath which serves as the true cathode. A connection is made to the bus bar 50 near a central point of the furnace and this connection passes under the furnace as indicated at 56, being adjacent to the connection 46. Connection 56 is joined to one member of the line 16. The bus bar 52 is connected to the other member of the line 16.

By this arrangement not only are the lines that run to the separate pots so arranged that current is flowing through adjacent conductors in opposite directions but this same effect is largely carried out in the pots themselves where the lines 46 and 56 are adjacent with the current flowing in opposite directions. Bars 44 and 52 are adjacent with the current flowing in opposite directions and likewise bus bars 48 and 50. Even as to the anodic bus bars 42, the current is fed in from both ends so that uni-directional flow is kept at a minimum. If desired the anodic bus bars 42 at each end of the furnace may be connected together as by connectors 58.

In the arrangement shown in Figs. 3 and 4, an anode bar runs out from each end of each pot to the general transmission area where these bars are interconnected.

In the same way a cathode bar runs out from each end of each pot to the general transmission area where they also are interconnected, and as before the anode bars and connections are positioned adjacent to the corresponding cathode bars and connections. In this case the cathode system of one pot is connected to the anode system of the next.

Current is fed through the line **60** to the anode system comprising the bars **62** which are interconnected as shown at **64**. At the end of each furnace, risers are connected to the bars **62** and are connected to the anode bus bars **66** which are arranged in a manner similar to the anode bus bars **42** previously described. The cathode bus bars **68** run along each side of the furnace and are interconnected at the ends by the bars **70** which are connected to the cathode bars **72** which in turn are interconnected in the general transmission area by the line **74**. A connection **76** runs from the corner of the cathode system of one pot to the anode system of the next adjacent pot.

As before, current passes in this manner down one line of pots and returns down the next adjacent line but in all cases the main transmission lines are arranged in adjacent pairs with the current flowing in opposite directions in nearby conductors so that the electro-magnetic action from one line counteracts that from the other and the net effect is reduced to a minimum.

It will be noted that in each of the examples the current supply of each pot is arranged symmetrically so that the current supply will flow in part from the ends towards the center and in part from the center towards the ends so that in this way also electro-magnetic effects are reduced.

In the arrangement heretofore used the electro-magnetic effect was particularly noticeable in connection with the pots at the end of a line where connections crossed over to the next adjacent line. When my invention is employed, the cross-over connections like the other connections, are so arranged that the electro-magnetic effect is kept to a minimum and as a result the end pots operate with high efficiency.

This invention is not only of importance in maintaining the level of the bath uniform in the pots where the aluminum is made but the suggested bus bar arrangement also improves working conditions in the furnace room. Heretofore the electro-magnetic effects were sufficiently strong to act detrimentally on any work done with tools or apparatus made of magnetic material. By reducing the magnetic fields to a minimum, an important improvement in working conditions will be obtained.

It is understood that the examples given are only intended as illustrations of various ways in which the circuits may be arranged to maintain the paired effect necessary to give the desired result.

What I claim is:

1. In an aluminum plant the combination of a plurality of substantially parallel pot lines, each pot line comprising a plurality of furnaces, each of which is an electrolytic cell comprising a pot serving as a cathode and holding the bath to be operated on and molten aluminum reduced in such pot, and each of said furnaces further comprising a movable anode which goes down into the bath, said furnaces in each pot line being connected together in series, conductors from a source of direct current leading to said pot lines and so arranged that the flow of current in adjacent pot lines is in opposite directions, conductors between adjacent pots in a line, each such conductor comprising a portion running from the cathode of a pot in towards the central zone between adjacent pot lines, a portion running through said central zone in a direction parallel to the pot lines and a portion running out from such central zone to the anode of an adjacent pot, such central portions of the conductors of one pot line which run through said central zone being so positioned that they are adjacent and parallel to corresponding central portions of conductors between pots in another pot line through which the current flows in an opposite direction to the flow in said first pot line so that the magnetic effect of the flow of current through one pot line is offset by the magnetic effect of the flow of current in such other pot line.

2. A structure as specified in claim 1 in which the portion of the conductor running in from the cathode of each pot toward the central zone runs adjacent and parallel to the conductor running out from said central zone to the anode of such pot whereby the magnetic effects of the flow of current in such conductors also tend to offset each other.

3. A structure as specified in claim 1 in which each pot has a single anode of the continuous type, supported from a bus bar above the anode and in which the conductors running to the anode of each pot are so arranged that the current is transmitted to such anode in part from one end and in part from the other end so that the magnetic effects of the flow of current in such anode conductors will tend to offset each other.

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