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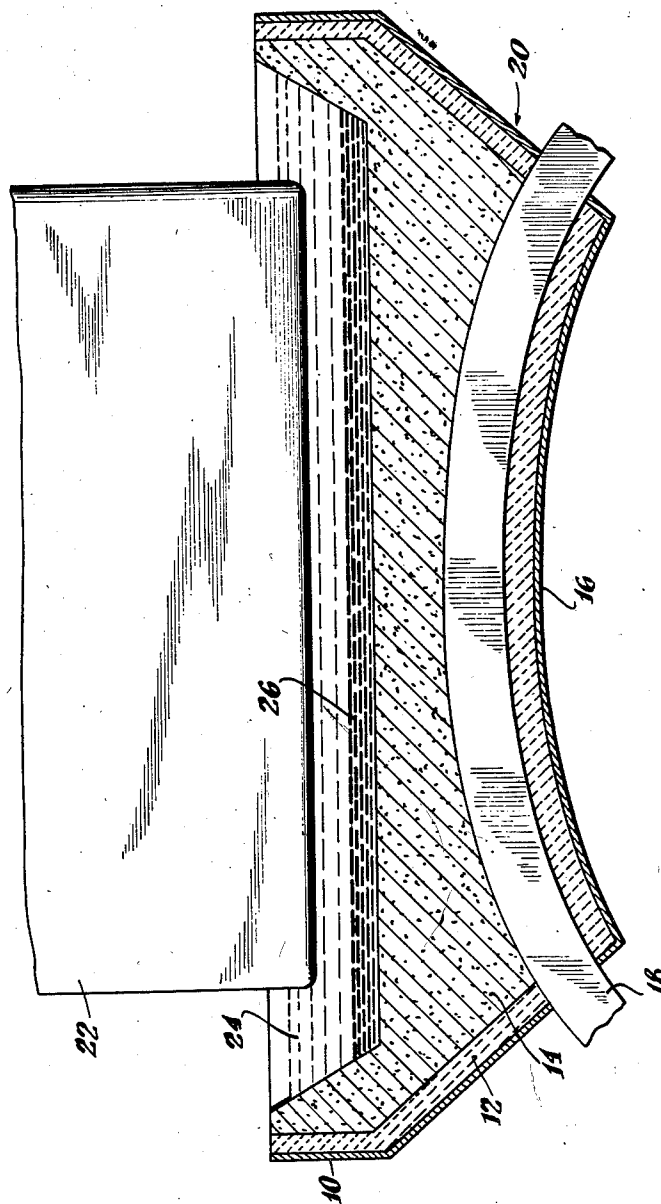
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ARRANGEMENT OF CATHODE BARS IN ELECTROLYTIC POTS

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2 Sheets-Sheet 1

Fig. 1.



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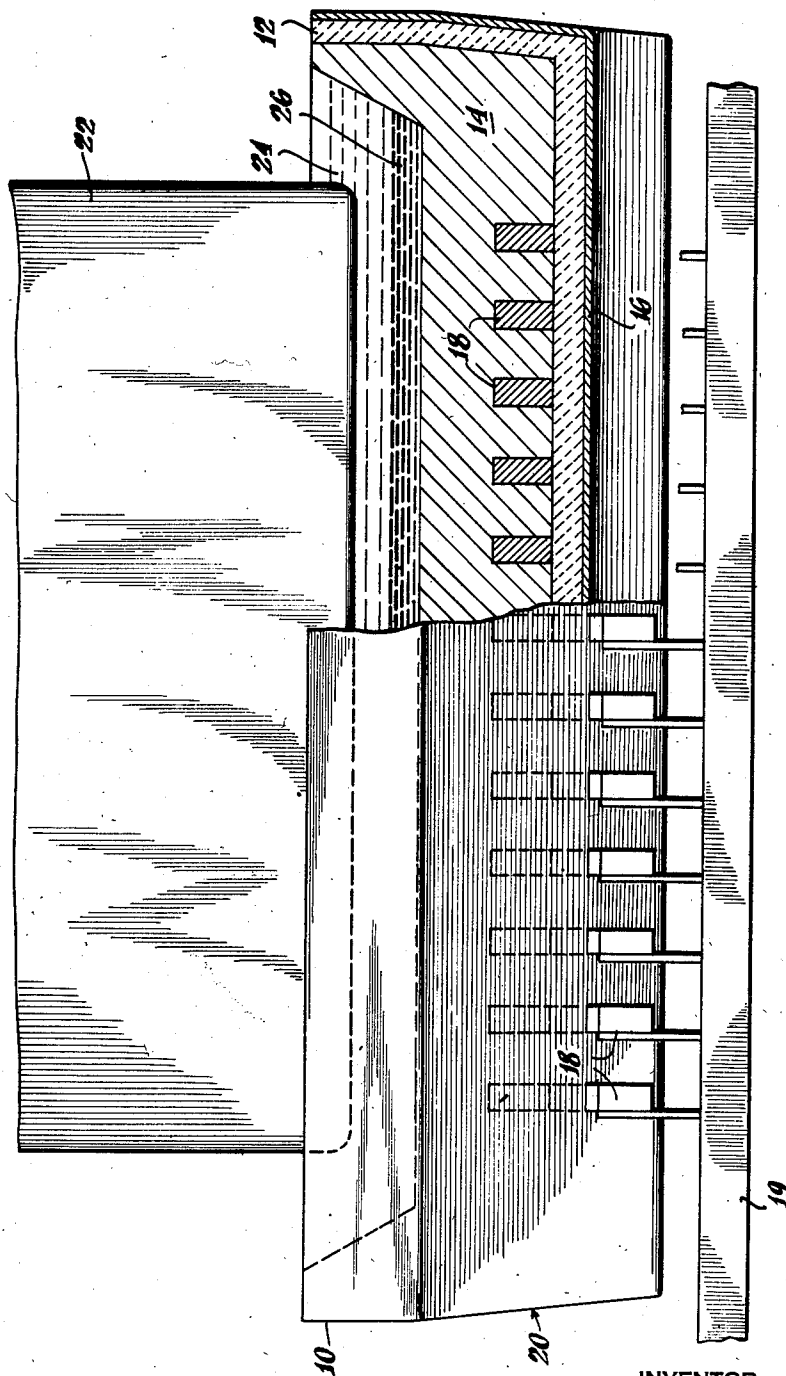
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Fig. 2



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ARRANGEMENT OF CATHODE BARS IN ELECTROLYTIC POTS

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6 Claims. (Cl. 204—243)

In the operation of very large aluminum pots which may use, for example, up to 100,000 amperes or more, the uniform distribution of current density over the whole area of the pot becomes an important factor.

In the ordinary construction of a furnace for use in the production of aluminum or the like using an anode large enough so that a single anode reaches largely across the pot as is customary in the so-called Soderberg furnaces, the actual pot in which the cryolite bath is placed and in which the molten metal is collected has a bottom lining of carbon and through this pass the cathode conductors which are made of ferrous metal (iron or steel).

I have found that the difference in conductivity of the iron cathode bars which pass through the carbon lining of such a pot as compared with the conductivity of the molten aluminum in the bath is sufficiently great so that there is an appreciable relative voltage drop from the center of the pot outward along the cathode bars. This means that there is an increased voltage differential between the melted aluminum adjacent the edges of the pot and the cathode bars in that area as compared with the voltage differential between the melted aluminum near the center of the pot and the central portions of the cathode bars. This creates a difference in current density between the central portions of the pot and the edges and this may set up strong horizontally directed electromagnetic forces in the molten aluminum.

According to the present invention, this difficulty is overcome by utilizing cathode bars which curve downwardly from the central part of the pot toward the edges so that the thickness of the carbon lining between the cathode bars and the molten aluminum is increased toward the sides of the pot. The amount of this curvature may vary within substantial limits. Some valuable results can be obtained if the lowering of the bars towards the edges of the pot as compared with the height at the center is as little as 3% of the width of the pot and it may range upward to as much as 15%. A preferred range is that the drop of the cathode bars from the center to the sides should be equal to between 4% and 8% of the width of the pot. While the drop of the cathode bars may follow a circular curve, I find it preferable to have the curve in the form of a rather flat parabola.

It is recognized that the voltage drop through the carbon lining in the bottom of a furnace pot varies between new pots and ones that have been used for some time. Thus the voltage drop may be 0.25 to 0.30 volt in a new pot, whereas in old furnace bottoms it may amount to from 0.7 to 0.9 volt. In the same way, the degree of curvature to get the best results will vary as the pot gets older. The new pot ordinarily would need a sharper curve than the old one. Of course it is not practicable to change the curvature as the pot is used and therefore in the new pot it is advisable that the curve be somewhat flatter than one which would give entirely perfect results in the new pot. In such case there will, during the first period of operation, be devel-

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oped weak horizontal current components directed toward the long sides of the furnace. Later, these will gradually disappear and eventually there may be weak horizontal current components directed across the furnace towards its central part. However, these horizontal current components will be much smaller than in the case where the usual straight horizontal cathode bars are employed.

When using curved cathode bars it is natural that the shape of the furnace bottom be somewhat different from that used with straight bars, and a form of furnace pot which can advantageously be used is shown in the accompanying drawings in which:

Fig. 1 shows a section through the furnace pot embodying my invention. This section is taken across the furnace on its shorter dimension; and

Fig. 2 shows a side view partly in section at right angles to the view of Fig. 1.

In this drawing, 10 represents the metal casing for the pot. Inside this is a usual layer of insulation 12 and inside the insulation 12 is the carbon lining 14. The bottom of the casing is curved downwardly from its center line towards the sides as indicated at 16, and the iron cathode bar 18 passes through the carbon lining approximately following the bottom curve. The cathode bars are connected at their ends in usual fashion to cathode bus bars 19 which connect the furnace with the next adjoining pot in the pot line as is customary. In this construction attention is particularly called to the fact that the sides of the outer furnace casing 10 are sloped inwardly as indicated at 20 so that the casing is narrower at the bottom than at the top with the result that the cathode bars emerge from the carbon lining at points approximately directly below the edges of the anode 22. This also is helpful in preventing the development of undue current density near the sides of the pot even apart from the curvature of the cathode bars. The top level of the cryolite bath is indicated at 24 and the level of the line between the molten aluminum and the cryolite bath is indicated by the broken line 26.

As regards dimensions, the maximum over-all width of the pot may, for example, be 12 feet and the drop in curvature of the cathode bar 18 between the center line and the place where it emerges from the casing may be between 5 and 10 inches. As previously brought out, this curvature should be somewhat less than would give perfect results with a new furnace pot and somewhat greater than would give perfect results when the pot gets old.

The particular shape of the sides of the pot as shown in the drawing possesses great advantages as regards heat insulation and mechanical strength in comparison with furnace pots of the usual type and this construction, while particularly suitable for use with the curved cathode bars, is advantageous even when used with flat bars. In like manner, the curved cathode bars are useful in pots of ordinary shape. As stated, the need for this invention is more apparent when the pot is designed for use with amperages ranging up to 100,000 amperes or more but it may advantageously be used with smaller furnaces such as those using amperages as high as 50,000 amperes which may be considered as a high amperage furnace.

What I claim is:

1. In combination, a substantially rectangular pot for the production of aluminum adapted for use in high amperage furnaces, an anode large enough so that it reaches largely across the pot, a carbon lining for such pot with a substantially flat inner surface below the bottom of the anode, cathode bars of ferrous metal imbedded in such lining running transverse the pot from one side to the other, and cathode bus bars connected to both ends of said cathode bars whereby current may be withdrawn

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from both ends of such cathode bars, such cathode bars being curved downwardly from the center toward the sides so that they are closer to the top of the lining at the center line of the pot than at the sides so that when current is withdrawn from said bars at the ends thereof, the increased thickness of carbon between the inner surface of the pot and the cathode bars at the sides as compared to the thickness of the carbon between the inner surface of the pot and the cathode bars near the center line, will act to compensate for the drop in potential due to the resistance of the cathode bars.

2. A structure as specified in claim 1 in which the curvature is such that the drop of the cathode bars from the center line of the pot to the sides is equal to between 3% and 15% of the width of the pot.

3. A structure as specified in claim 2 in which the curvature of the cathode bars is flat enough so that when the pot is new, there will be weak horizontal current components directed toward the sides of the pot.

4. A structure as specified in claim 2 in which said downward curve of the cathode bars is parabolic.

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5. A structure as specified in claim 1 in which the pot has sides sloping inwardly toward the bottom below the level of the bottom of the anode so that the width of the pot near its bottom is approximately equal to the width of the anode.

6. A structure as specified in claim 5 in which the pot has a bottom which is downwardly curved from its center line towards the sides and in which the curvature of the bottom approximately follows the curvature of the cathode bars.

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