Jan. 17, 1967 G. H. WEIS ETAL 3,298,945

ELECTROLYTIC CELL INCLUDING A STARTING CATHODE HAVING AN INTEGRAL SUPPORTING MEANS

Filed Sept. 24, 1962 3 Sheets-Sheet 1

Fig. 1.

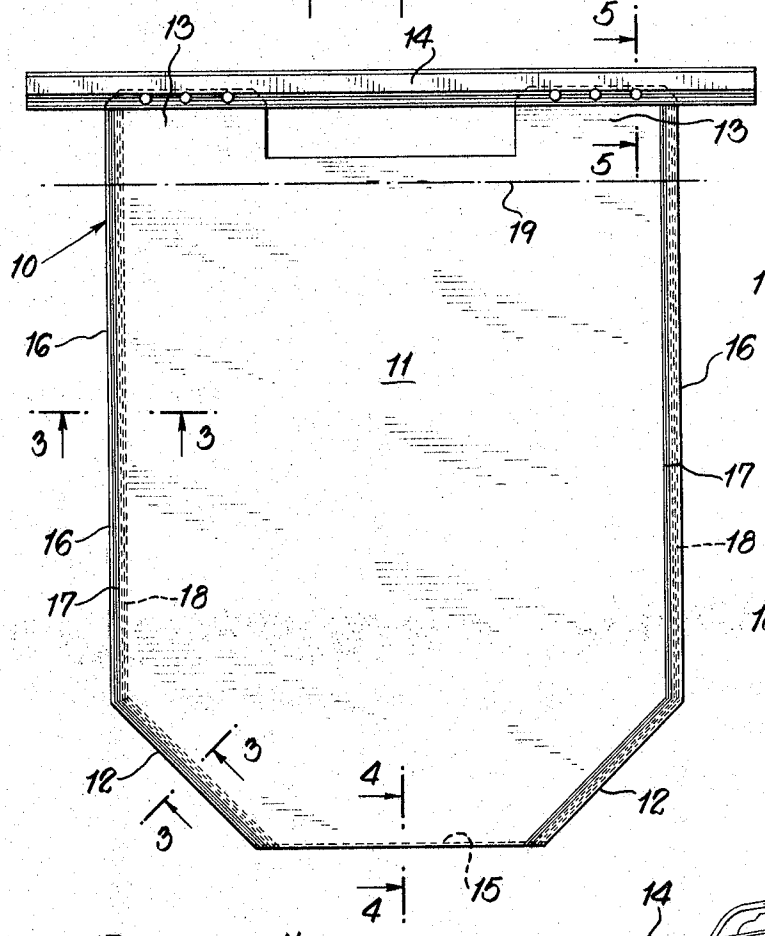


Fig. 2.

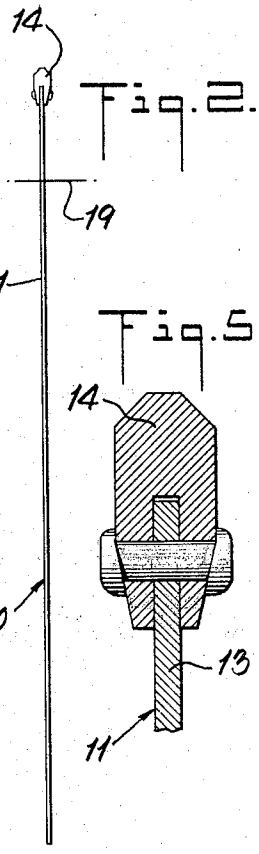


Fig. 5.

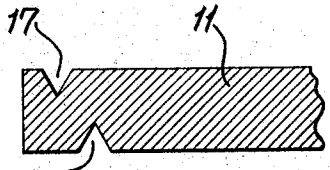


Fig. 3.

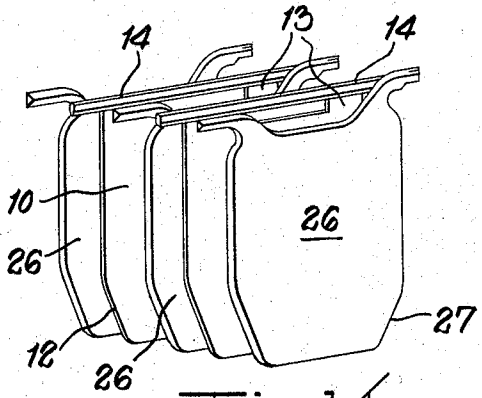


Fig. 14.

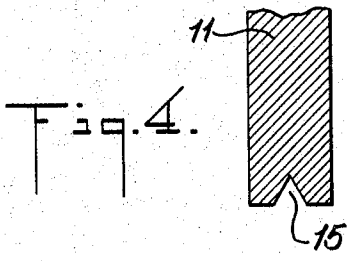


Fig. 4.

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Filed Sept. 24, 1962 3 Sheets-Sheet 2

Fig. 6.

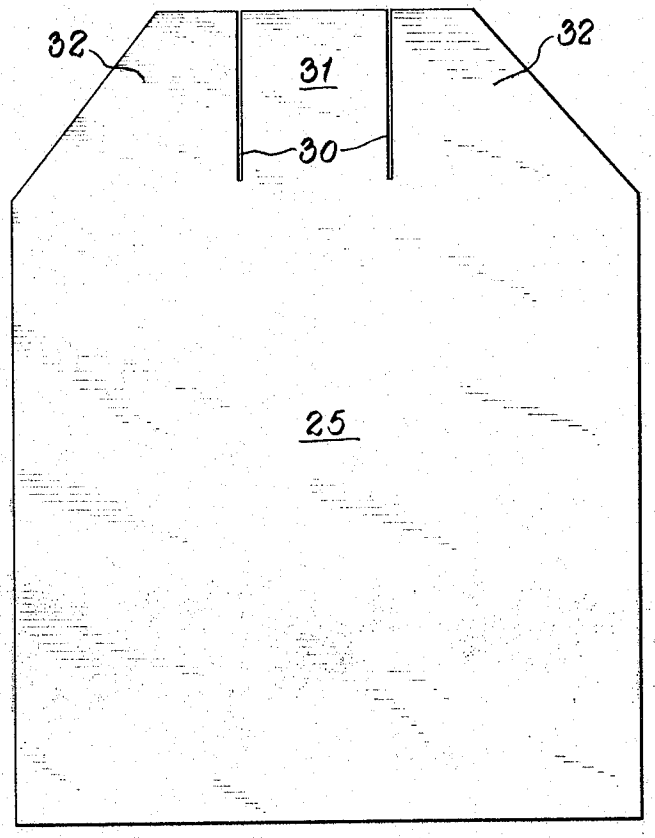


Fig. 8.

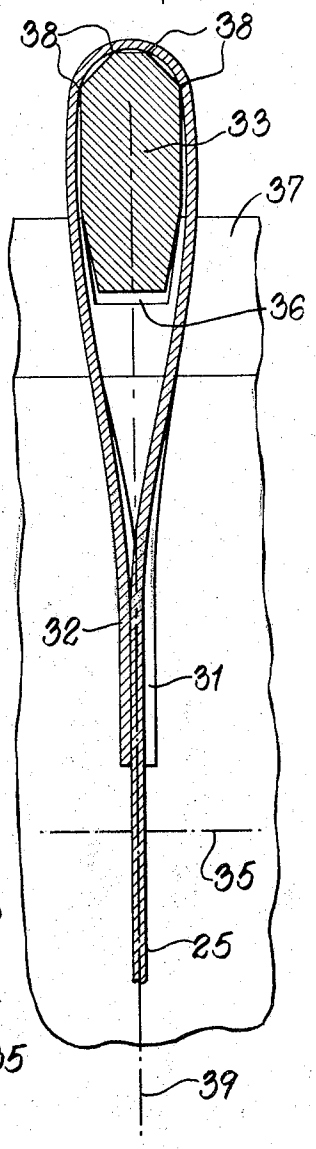
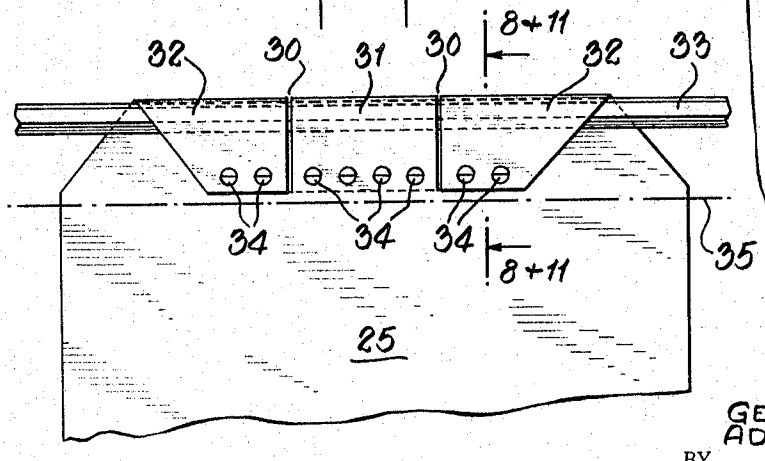


Fig. 7.



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Filed Sept. 24, 1962 3 Sheets-Sheet 3

Fig. 9.

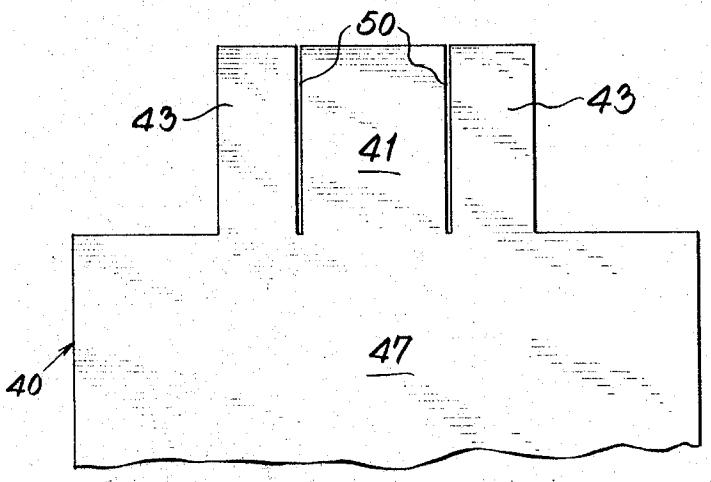


Fig. 10.

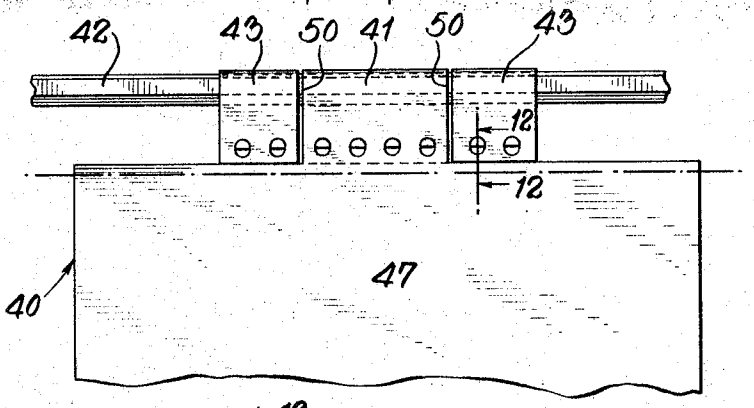


Fig. 11.

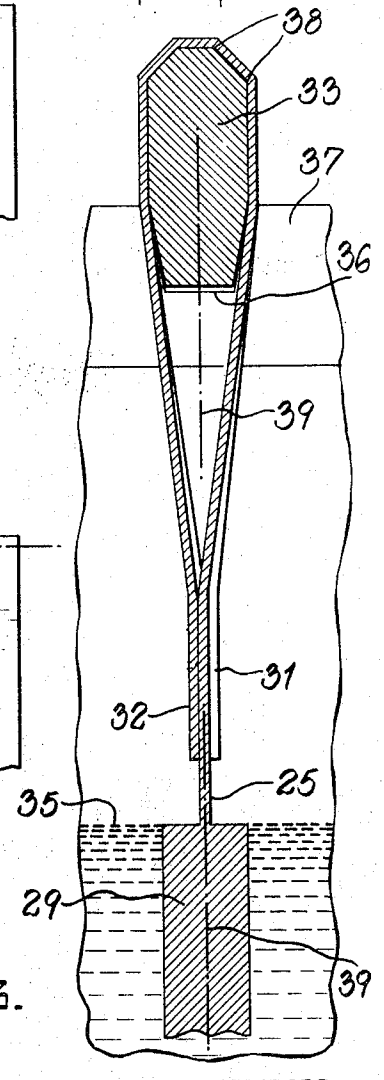


Fig. 12.

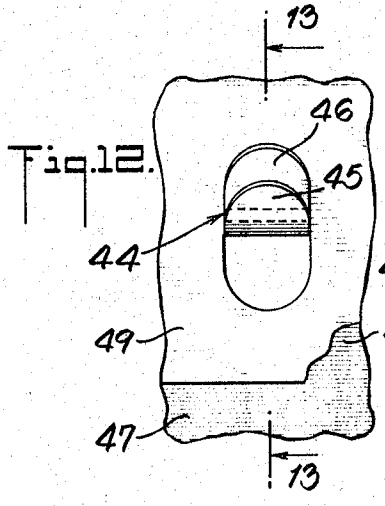
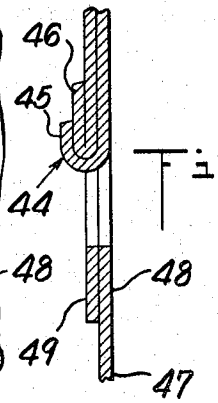


Fig. 13.



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3,298,945

ELECTROLYTIC CELL INCLUDING A STARTING CATHODE HAVING AN INTEGRAL SUPPORTING MEANS

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Filed Sept. 24, 1962, Ser. No. 225,524
3 Claims. (Cl. 204—242)

This invention relates to the electrodeposition of metals and, more particularly, to starting sheets or starting cathodes for copper refining.

In conventional electrolytic refining of copper, the blister impure copper to be refined is cast in plate form as anodes. These are suspended in electrolytic tanks in alternation with copper starting sheets. The electrolysis dissolves the copper from the anodes and deposits it on the cathode starting sheets while the insoluble impurities collect at the bottom of the tank in the form of anode mud or slime.

The copper starting sheets are made by electrolytically depositing copper on special hard rolled copper plates sometimes called starting blanks. The starting blanks are suspended in special starting tanks in alternation with blister copper anodes. The electrolysis dissolves copper from the anodes and deposits it on the cathode starting blanks. When the deposit reaches a thickness of say 0.025 in., it is stripped from both sides of the starting blank and formed into the above mentioned starting sheets.

The starting blanks are non-consumable and are used over and over again. The starting blanks are usually rectangular and suitably riveted to a bar which is suitably supported on electric contacts on the side of the tank.

After the starting sheets are stripped from the starting blank, in one conventional operation, they are provided with separate loops for suspension from cathode bars in the main production electrolytic tanks. One sheet out of every five is cut into four squares. Each square is bent to form a U-shape loop. One loop is disposed at the middle of the upper edge of a starting sheet with a leg on either side, and fastened thereto by a suitable joint. Such joint may be formed by puncturing the superimposed legs and sheet and then bending the metal of one leg through the openings in the sheet and other leg, and riveting it over onto the other leg.

The starting sheets are then "paddled" to make them as flat or plane as possible. They are then placed in the main electrolytic tanks in alternation with the blister copper anodes. The solution line reaches to approximately the top edge of the sheet, immersing the joints which attach the loops.

The above practice has a number of disadvantages. The electric resistance of the joint between the separate loop and the sheet is so high, and its mechanical strength is so low, that, in practice, this joint is immersed below the surface of the electrolytic sulphuric acid bath to take a deposit of copper. This in turn is open to the objection that the joint so immersed becomes contaminated with electrolyte trapped between the layers of metal. This adds sulphur to the electrolytic copper. In addition, the practice is wasteful in that it requires one starting sheet of every five to form the loops for the remaining four starting sheets.

Objects of the invention are to provide a novel starting sheet, a novel starting blank, and a novel method of making a starting sheet, which overcomes the above disadvantages, and to provide a starting sheet which has corresponding advantages; electrical, metallurgical and economic.

According to a preferred form of the present invention, a starting sheet is provided with three integral tongues at the upper edge of the sheet body. The central tongue is bent in one direction around a cathode bar, and the side tongues are bent in the opposite direction, around the cathode bar. The ends of the tongues are secured to the roots of the tongues by suitable joints. One form of joint may be made by stamping copper from the end of the tongue and pressing it through the root of the tongue and riveting it over. The sheets are placed in the electrolyte with the joints above the solution line.

If desired, the side tongues at the upper margin of the starting sheet may have a beveled configuration to form spaces at the sides of the sheet for crane hooks. The starting blanks on which the starting sheets are formed may also have a special beveled lower portion to electrolytically deposit a starting sheet of corresponding shape, and to facilitate stripping the starting sheets from the starting blanks.

Other objects and features of the invention will be more apparent from the following description when considered with the accompanying drawings in which:

FIG. 1 is a side elevation of the new starting blank in the position occupied when in the electrolytic tank, the liquid level being indicated by dot and dash lines.

FIG. 2 is an edge elevation of FIG. 1.

FIG. 3 is a detail section, taken on the lines 3—3 of FIG. 1, showing offset marginal grooves to facilitate stripping.

FIG. 4 is a detail section, taken on the line of 4—4 of FIG. 1, illustrating an edge groove used to facilitate stripping.

FIG. 5 is a section, taken on the line 5—5 of FIG. 1, illustrating a manner of suspending the starting blank.

FIG. 6 is a side elevation of a starting sheet after it is stripped from the starting blank, and with slots cut in the upper beveled portion, prior to formation of the suspension loops.

FIG. 7 is a fragmentary side elevation of the starting sheet of FIG. 6, showing the loops around a cathode bar.

FIG. 8 is a sectional detail, taken on the line 8—8 of FIG. 7, illustrating the oppositely disposed loops around the cathode bar. This figure also illustrates the symmetrical disposition of the loops and of the starting sheet about a vertical center line.

FIG. 9 is a fragmentary elevation of a modified form of starting sheet, corresponding to FIG. 6.

FIG. 10 is a fragmentary side elevation of the starting sheet of FIG. 9, with its suspension loops hung from a cathode bar.

FIG. 11 is a section, taken on the line 11—11 of FIG. 7, showing the symmetrical arrangement of oppositely disposed loops and of the starting sheet about a vertical center line, after loops are pulled taut by weight of deposited metal.

FIG. 12 is a sectional detail, taken on the line 12—12 of FIG. 10, illustrating the one type of point connecting the free ends of the tongues to their roots to form the loops.

FIG. 13 is a section, taken on the line 13—13 of FIG. 12.

FIG. 14 is detail perspective illustrating the alternate arrangement of beveled starting blanks and beveled starting anodes.

In the following description and in the claims, various details will be identified by specific names for convenience, but they are intended to be as generic in their application as the art will permit.

Like reference characters denote like parts in the several figures of the drawings.

In the accompanying drawings and description forming part of this specification, certain specific disclosure of the invention is made for purposes of explanation, but it will be understood that the details may be modified in various respects without departure from the broad aspect of the invention.

Referring now to the drawing, and more particularly to FIGS. 1–5 and 14, the new starting sheet requires a special form of starting blank and starting anode. The starting blank will first be described.

The starting blank **10** comprises a plate of hard rolled copper **11** having beveled lower corners **12** and a notch in its top edge forming suspension ears **13**. It is suspended from a bar **14** having a bottom groove in which the ears **13** are held by rivets. The bar **14** rests on suitable electrical contacts supported by the edge of the tank (not shown).

The lower edge of the blank has an edge groove **15**, and the vertical margins **16** and beveled margins **12** have marginal grooves **17**, **18** on opposite faces. These are to facilitate stripping the starting sheets from the blanks, as hereinafter described more in detail.

The dimensions may vary with the design of the tank house. In one form the starting blank may be about 38 in. wide and may be about 48 in. from the bottom edge up to the solution line **19**. The blank may be about 3/16 in. thick and the grooves may be about 1/16 in. deep. The marginal grooves **17**, **18** (FIG. 3) are offset so as not to weaken the plate.

It will be noted from FIG. 1 that the left marginal groove **17** is nearer the edge than the left marginal groove **18** on the opposite face; similarly, the right marginal groove **17** is further from the edge than the right marginal groove **18** on the opposite face. This equalizes the width of the sheets stripped from opposite faces of the blank.

The manner of making the new starting sheets **25** will now be described. As shown in FIG. 14, the special blister copper anodes **26** and the starting blanks **10** are placed in alternation in a special starting tank (not shown). As indicated, the anodes **26** are especially cast with beveled edges **27** to correspond to the bevels **12** on the starting blanks **10**. Copper from the anodes **26** dissolves and deposits on both sides of the starting blank **10**. When the deposit reaches a desired thickness, the sheets are stripped from the blank. For example, a 24 hour continuous deposit may produce a starting sheet of about 0.025 in. thick.

To strip the deposits from a starting blank, knives are inserted along the upper edge of the deposit (corresponding to line **19** in FIG. 1) and the deposit sheets on either side of the starting blank **10** are separated along the weakening lines formed by the weakening margin grooves **17** and **18**, along vertical margins **16** and bevels **12**, and along edge groove **15**.

The material deposited between the marginal grooves **17** and **18**, around the vertical and beveled edges, is removed as scrap. This leaves slight protuberances on the starting sheets along the vertical and beveled edges. The seperation along bottom groove **15** leaves greater protuberances on the starting sheets, but this is of no movement because these protuberances are not submerged in the electrolyte. It will be understood that the immersed protuberances should be as small as possible to minimize undesired growth of deposit.

Each starting blank **10** produces two starting sheets **25** of a shape corresponding to the shape of starting blank body **11** in FIG. 1 below solution line **19**. The beveled end of the deposit which is formed at the bottom of the starting blank **10** becomes the top of the starting sheet **25** in FIG. 6.

Referring to FIGS. 6–8 and 11, the starting sheet will now be described. As indicated in FIG. 6, the beveled end of the starting sheet **25** is provided with slots **30** of appreciable width. These slots may be about 10 in. long and about 1/8 in. wide. These two slots form a middle tongue **31** and two side tongues **32**.

These tongues **31**, **32** are bent around a cathode bar **33** (FIGS. 7 and 8) in opposite directions, to form loops. The middle tongue **31** is bent in one direction and the side tongues **32** are bent in the other direction. The ends of the tongues are fastened to roots of the tongues by joints **43**. These joints may be formed by striking out tabs and bending them through holes in the tongues, in a manner generally similar to those shown in FIGS. 12 and 13 and described hereinafter.

The free end of the tongues **31**, **32** are so arranged as to be about 1/2 in. above the solution line **35** (FIG. 7) and the joints **34** corresponding higher, when the starting sheet is suspended from the cathode bar **33** in the production tank. The deposit area on body of the starting sheet **25** below the solution line **35** may be about 37 in. wide and about 37 in. high.

For the electrolytic refining operation, the starting sheets **25** and cathode bars **33** are placed in the regular electrolytic tanks in alternation with blister anodes as is well understood in the art. The electrolysis is started and the copper deposits on both sides of the starting sheet **25**. After say fourteen 24-hour days of continuous electrodeposition, the starting sheet with deposited copper may weigh about 285 lbs. The completed cathode and bar is then removed bodily from the tanks. The cathode sheet, after removing the cathode bar **33**, is then delivered to the melting furnace for further refining.

Cathode bars **33** have a standard polygonal shape. They may be of the type disclosed in Aubel Patent 1,745,348, dated Feb. 4, 1930. The lower wedge-shaped sides rest in a similarly shaped groove **36** in socket member **37** (FIG. 8) to make electrical contact with the adjoining cell. The starting sheet loops **31**, **32** hanging from the cathode bar **33** make electric contact, especially with the top corners **38** of the bar when the starting sheet **25** is first suspended in the tank, as shown in FIG. 8. As the cathode gains weight, the loops **31**, **32** straighten out, and pressure of the loops on the bar and the area of contact between loop and bar increases, as shown in FIG. 11. Here the deposit of copper is denoted by **29**.

The folding of the loops **31**, **32** in opposite directions and the free ends of the tongues on opposite faces of the starting sheet **25** permits the starting sheet **25** to be suspended truly symmetrically with respect to the cathode bar **33**. This is illustrated by the center line **39** in FIG. 8 passing through the center of the bar **33** and the central plane of the sheet **25**.

Furthermore, as the starting sheet gains weight, and the loops are drawn taut around the bar, the suspension remains symmetrical and there is no tendency to rotate the bar. Compare with FIG. 11. The pull exerted by the loops is symmetrical, the pull on one side balancing the pull on the other, so there is no tendency to rotate the bar. The maintenance of symmetry, with downward movement of the starting sheet due to metal accretion, is important in maintaining proper spacing between cathode and anodes on either side. This avoids the evils of excessive spacing on one side and actual physical contact on the other side.

Referring now to FIGS. 9–13, a modified form of starting sheet **40** is shown. Slots **50** form tongues **41**, **43**. Here the center tongue **41** is bent around the cathode bar **42** in one direction and the side tongues **43** are bent around the cathode bar in the other direction. Here the bevels are omitted, the side tongues **43** defining a right angle corner with the body **47** of the sheet.

The starting sheet will be formed by deposition on a starting blank, using blister copper anodes, of shapes corresponding to the shape of blank shown in FIG. 9, in a manner generally similar to forming the starting blank of FIGS. 6–8.

The loops **41**, **43** are formed by fastening the ends of the tongues to their roots by joints **44** illustrated by FIGS.

12 and 13. Joints 44 are conveniently formed by a simple punching operation. As shown, the punch perforates the root 48 and free end 49 of the tongue forming tabs 45, 46 and pushes tab 45 of root 48 through the holes in free end 49 and rivets the tab 45 over against the tab 46 which is pressed against free end 49.

If desired, a single rectangular loop might be used in place of the separate loops in FIGS. 7 and 10. This could be made simply by omitting the slots 30 and 50 in these figures and bending the single tongue in one direction over the cathode bar and then fastening to the body of the sheet by any suitable joint, as for example, that illustrated in FIGS. 12 and 13. Or, the width of the loop may equal the width of the body of the starting sheet. These alternative forms would still have the advantages of reducing the electrical resistance between the loop and body of the starting sheet and of eliminating the catch pockets formed by joints below the solution line.

The beveled corner form shown in FIGS. 6 and 7 is preferred because of ease of stripping and because the end spaces enable use of simplified equipment for removing the entire tank of cathodes by overhead crane. The form shown in FIGS. 6 and 7 is easier to strip than the inside corner form shown in FIGS. 9 and 10.

The central disposition of the loops in FIGS. 6 and 7 and in FIGS. 9 and 10 provides for good electrical contact along their entire length when looped around the cathode bar. If the loops are spaced at the extreme sides of the starting sheet, it is more difficult to obtain a good electrical contact along their entire length because of difficulty in aligning the loops perfectly before punching the joints.

In both forms of FIGS. 6 and 7 and of FIGS. 9 and 10, the free end of the central tongue is twice the width of the end tongues. FIG. 7 has the advantage, when compared with FIG. 10, in providing greater contact area with the cathode bar, which reduces electrical resistance.

The invention has numerous advantages; economic, electrical and metallurgical. It reduces the number of starting tanks by 20% by making it unnecessary to use one sheet out of every five for loop material. It eliminates one area of electrical resistance, namely the joints for fastening the separate loops to the starting sheets. It eliminates the catch pockets formed by the joints disposed below the solution line which catch the electrolyte and the impurities present in the blister copper, namely sulfur, gold, silver, nickel, selenium, tellurium, arsenic, antimony, etc. The beveled edges assist in the stripping operation, and provide end clearance spaces for the crane hooks.

While certain novel features of the invention have been disclosed herein, and are pointed out in the annexed claims, it will be understood that, in accordance with the doctrine of equivalents, various omissions, substitutions and change may be made by those skilled in the art without departing from the spirit of the invention.

What is claimed is:

1. In an electrolytic cell for the electrodeposition of metal comprising an anode and a cathode starting sheet having a body constituting a deposit area for immersion in an electrolyte, a cathode bar for supporting the cathode starting sheet, means for hanging said starting sheet from the bar, and means supporting the cathode bar to maintain said starting sheet immersed in an electrolyte, the improvement which comprises providing as the cathode starting sheet bar hanging means integral loop means at the upper edge of the cathode starting sheet body, said loop means having a portion constituting an integral extension of said starting sheet body and including at least three tongues extending generally in the same direction, spaced apart from each other thereby defining slots therebetween, and bent in opposite directions to form side by side loop tongues, the cathode bar being disposed in said loop means, and joint means securing a free end of the loop means integral extension surrounding said bar to said sheet, said joint means being disposed above the level of the electrolyte, whereby said sheet is suspended truly symmetrically with respect to said cathode bar and entrapment of electrolyte between metal layers at the joint is eliminated with attendant elimination of impurities addition to the electrodeposited metal.

2. In the cell of claim 1, said bar having a polygonal upper face providing a series of corners extending lengthwise of the bar, said loops straightening to conform to said polygonal surface as said starting sheet gains weight from the metal electrodepositing thereon.

3. In the cell of claim 1, the upper corners of said sheet being beveled to facilitate stripping from the starting blank and to provide spaces for crane hooks.

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