Fig. 3.

Fig. 4.

Fig. 5.

Fig. 7.

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STRIPPING OF SHEET METAL ELECTRODEPOSITS FROM STARTING SHEET BLANKS
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ABSTRACT OF THE DISCLOSURE
One or more loops are attached, preferably by spot welding, to the sheet metal electrodeposits on the main depositing surfaces of starting sheet blanks, and the electrodeposits are stripped from the depositing surfaces by a pulling force applied to the electrodeposits by means of or with the aid of the loop or loops. Care is exercised during the attachment of the loops to the electrodeposits not to damage the starting sheet blank. The invention is especially useful in the stripping removal of electrolytic copper sheet deposits from the starting sheet blanks for forming copper cathode starting sheets for use in the electrolytic refining of copper.

BACKGROUND OF THE INVENTION
Field of the invention
This invention relates to stripping of electrolytic sheet metal deposits from starting sheet blanks, and more particularly to a new and improved starting sheet blank-removable sheet metal electrodeposits assembly and to a new and improved method for effecting the stripping removal of sheet metal electrodeposits, for instance copper cathode starting sheets, from starting sheet blanks.

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

The copper cathode starting sheets are produced by electrolytically depositing copper on special hard rolled copper plates referred to as starting blanks or starting sheet blanks. The starting blanks are suspended in special starting tanks in alternation with blister copper anodes. The electrolysis dissolves copper from the anodes and depost it on the cathode starting blank. When the metal deposit reaches a thickness of typically about 0.025 inch, the starting sheet blank with sheet copper electrodeposits on its opposite sides is removed from the tank and the thin copper sheets are stripped from the blank.

In the past, the thin sheet copper electrodeposits have frequently been removed manually from the main depositing surfaces on opposite sides of the starting blank by means of a knife or chisel inserted between the sheet copper electrodeposits and the starting sheet blank plate at a relatively weak line formed in the copper electrodeposits due to a shallow groove previously cut into the starting sheet blank. This manual stripping removal was cumbersome, expensive due to the considerable time and manpower requirements for the stripping and handling, and tending to develop irregularities in the removed sheets.

SUMMARY OF THE INVENTION
In accordance with the present invention, I have found that by attaching one or more loops to the sheet metal electrodeposits, for instance sheet copper electrodeposits, on the main depositing surface or surfaces of the starting sheet blank metallic plate and by a bond or bonds of attachment of sufficient strength to enable subsequent stripping removal of the sheet electrodeposits from the main depositing surface by means of or with the aid of the loop or loops, the stripping removal of the sheet electrodeposits from the depositing surface is achieved in an efficient, economical and generally trouble-free manner by applying a pulling force to the sheet metal electrodeposits by means of or with the aid of the loop or loops. The pulling force is that sufficient to separate the sheet electrodeposits from and draw the electrodeposits away from the main depositing surface or surfaces. In addition to achieving the stripping of the sheet metal electrodeposits from the starting sheet blank efficiently, economically and in a generally trouble-free manner, the present invention in a preferred embodiment provides an assembled cathode starting sheet equipped with hanger or suspension loops and a hanger bar inserted through the loops for suspending the cathode sheet in the electrolyte tank.

Further, by reason of the loop or loops attached to the sheet metal electrodeposits or electrodeposits in accordance with this invention, the stripping removal can be carried out automatically as is hereinafter described as contrasted with the manual stripping of the sheet electrodeposits from the starting sheet blank plate practiced in the prior art.

The loop or loops are attached only to the sheet metal electrodeposits on the starting sheet blank plate, and care should be taken during the attachment of the loop or loops to the sheet electrodeposits not to damage the starting blank.

The starting sheet blank-removable sheet metal electrodeposit assembly of the present invention comprises a starting sheet blank metallic plate having one or more and usually two main depositing surfaces, and a sheet metal electrodeposits on each main depositing surface. Means are provided for rendering the sheet electrodeposits separable along the edge portions of the main depositing surface. One or more loops is attached to the sheet metal electrodeposits, with the bond of attachment of the loop to the sheet electrodeposits being of strength sufficient to enable stripping removal of such electrodeposits from the main depositing surface of the starting sheet blank by means of or with the aid of the loop or loops.

The loops are usually of metal and the metal is usually the same metal as that of the sheet metal electrodeposits. Thus for the stripping of sheet copper electrodeposits from the main depositing surfaces of the starting sheet blank, the loop or loops are usually of copper. The loops usually comprise a bent metal band or strip. However, the loop or loops can be of any suitable material possess-
The stripping removal method of the present invention, in its broader aspects, involves applying a pulling force to the sheet metal electrodeposited or electrodeposited on the starting sheet blank by means of or with the aid of the loop or loops attached to the electrodeposited, and of sufficient magnitude to separate the sheet electrodeposited from and draw the electrodeposited away from the main depositing surface of the starting blank. The stripping removal can be carried out automatically as is hereinafter described in detail, or, if desired, the stripping removal herein can be carried out manually.

In another embodiment of the stripping removal method herein, the loop or loops are attached to only the sheet metal electrodeposited or electrodeposited on the starting sheet blank, prior to the application of the pulling force to separate the electrodeposited from and draw them away from the starting sheet blank.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

When one loop is employed, the loop is preferably of a relatively wide band or strip of metal typically about 185⁄₄" in width and typically about 19" in length prior to bending to form the loop. When two loops are employed, the loops are preferably each of a relatively narrow band or strip of metal, typically about 41⁄₄" in width and typically about 18" in length prior to bending to form the loop. The metal loops are preferably attached by spot or stud welding to only that side or face of the sheet metal electrodeposited not in contact with the depositing surface of the cathode starting sheet. The metal loops are also preferably attached to the lower portions of the sheet metal electrodeposited on the main depositing surfaces of the starting blank plates. The lower portion of the sheet copper electrodeposited at least are normally thicker and intermediate portions thereof and, inasmuch as the bottom and the lower portions of the sheet copper electrodeposited with the loops welded thereto are reversed, after the stripping removal from the starting blank plate, and become the top and upper portions of the copper cathode starting sheets which hang from the suspension means, the electrodeposited tank wall with strength hence being important in the top and upper portions of the copper cathode starting sheets, the preference in welding the loop or loops to the lower portions is readily apparent. The narrow loops, or the wide loop, are attached to the lower portion of the sheet metal electrodeposited on the blank with a distance of overlap on the electrodeposited typically from about 2"–3".

The pulling force is preferably applied to the sheet metal electrodeposited or electrodepositos to separate and draw the electrodeposited away from the main depositing surface away from the starting sheet blank, and the hanger bar inserted through the loop or loops attached to each electrodeposited. The loop or loops are preferably left attached to the sheet copper electrodeposited after its stripping removal from the starting sheet blank, and the hanger bar is preferably left inserted through the loop or loops attached to the stripped or removed sheet copper electrodeposited, whereby the removed sheet copper electrodeposited can be suspended by means of the loop or loops and hanger bar into the electrolyte tank as a cathode starting sheet.

The copper loops are preferably spot or stud welded to that side only of the electrolytic sheet copper deposit which is farthest removed from the main depositing surface of the starting sheet blank plate, by substantially pure molten copper applied in an inert gas, e.g., argon, envelope from a substantially pure copper filler wire inserted through registering pre-punched holes in opposite end portions of the loop. At the point of its contact with the sheet copper electrodeposited, the copper filler wire breaks up into a spray of molten copper droplets surrounded by argon or another inert gas, whereby a substantially pure copper stud and weld is built up. During this spot welding, the penetration of the molten copper through the "daughter" sheet, i.e. the sheet copper electrodeposited, is stopped by the chilling effect of the mass of the "mother" sheet, i.e. the starting sheet blank, whereby there is no damage done to the starting sheet blank. Occasionally there may be a slight penetration of the "daughter" sheet by the molten copper weld metal, but there is generally speaking no substantial surface damage to the "mother" sheet although there may be some discoloration of the surface of the "mother." Preferably the prepunched holes through the opposite end portions of the loops are only partially pierced through such end portions, and a generally horizontal lip extends outwardly from the bottom portion of each hole whereby retention of molten copper weld metal in the holes is facilitated.

Means are preferably provided on the main depositing surfaces of the starting sheet blanks to facilitate separation and hence stripping of the sheet metal electrodeposited from each depositing surfaces. Such means are exemplified by an oil-in-water emulsion. Such emulsion is applied preferably by dipping the starting sheet blank wherein to coat the depositing surfaces therewith, followed by removing the blank and draining the excess thereof from the blank.

After its stripping removal from the starting sheet blank, the sheet copper electrodeposited is preferably flattened in a suitable press to remove unevenness, kinks and undulations in the sheet surface.

BRIEF DESCRIPTION OF THE DRAWINGS

Reference is now made to the accompanying drawings wherein.

FIG. 1 is a side elevational view of a preferred starting sheet blank-sheet metal electrodeposited assembly of the present invention having loops securely attached to each electrodeposited and with a hanger bar inserted through the loops attached to each electrodeposited;

FIG. 2 is a detail sectional view partially broken away of the starting sheet blank-sheet metal electrodeposited assembly of FIG. 1;

FIG. 3 is a side elevational partially broken away of another embodiment of a starting sheet blank-sheet metal electrodeposited assembly of this invention having a loop securely attached to each electrodeposited, and with a hanger bar inserted through the loop attached to each electrodeposited;

FIG. 4 is a detail sectional view partially broken away of another preferred embodiment of the starting sheet blank-sheet metal electrodeposited assembly of the present invention.

FIG. 5 is a fragmentary sectional view taken on line 5–5 of FIG. 3;

FIG. 6 is a diagrammatic representation of a system for automatically stripping sheet copper electrodeposited from starting sheet blanks; and

FIG. 7 is a fragmentary sectional view taken on line 7–7 of FIG. 1.

Like reference characters denote like parts in the several figures of the drawings.
DETAILED DESCRIPTION OF THE DRAWINGS

Referring to FIGS. 1—5 and 7, starting sheet blank plate 10 of hard rolled copper has sheet copper electrodeposits 11 and 12 on its main depositing surfaces. In the preferred embodiment of FIG. 1, two relatively narrow loops 13 and 14 formed of a copper strip or band are spot or stud welded with copper filler wire inserted through pre-punched holes 15 in opposite ends of such copper band to only the external face of each copper electrodeposition on each main depositing surface of blank plate 10. Loops 13 and 14 are of width of typically 4", and holes 15 of diameter of typically 1/2". In the other embodiment of FIG. 3, one relatively wide loop 48 formed of a copper strip or band is spot or stud welded with the aid of copper filler wire inserted through pre-punched holes 49 in the opposite ends of such copper band to only the external face of each copper electrodeposition on each main depositing surface of blank plate 10. Loop 48 is of width of typically 12", and holes 49 each of diameter of typically 1/2". As shown, hanger bars 17 and 18 are inserted in a preferred embodiment of this invention through the loops and serve to suspend the sheet copper electrodepositions as cathode starting sheets, after stripping of such electrodepositions from the starting sheet blank plate 10, in the copper electro-refining tank.

Channel members 42, 43 and 44 of electrically insulating material are inserted over the side edge portions and bottom edge portion of starting sheet blank plate 10, to enable separation of the sheet metal electrodeposition from plate 10 along the side and bottom edge portions of plate 10. The electrically nonconductive material of the channels can be, for example, of acid-resistant plastic coated on stainless steel channel members, or the channel members can be formed entirely of an acid resistant plastic e.g. polyethylene; ABS, i.e. acrylonitrile-butadiene-styrene teropolymer, or polyvinyl chloride. Instead of the channel members, a groove can be employed in the marginal edge portions and bottom edge portion of the blank to enable separation of the metal electrodeposition from such edge portions of the blank.

As shown in FIG. 4, the registering pre-punched holes 15a in the opposite end portions of the loop are only punched or punched through such opposite ends. Consequently generally horizontal lip 15b extends outwardly from the bottom portion of each hole, whereby retention of molten weld copper in the holes is facilitated.

Referring to FIGS. 1 and 3, starting sheet blank plate 10 has notch 45 in its top edge forming suspension ears 46. Plate 10 is suspended from a bar 47 having a bottom groove in which the ears 46 are held by rivets. Bar 47 rests in suitable electrical contacts supported by the edge of the electrolyte tank (not shown). Plate 10 receives removable electrolytic sheet copper deposits upon its immersed main depositing surfaces from a copper-containing anode when partially immersed in an electrolyte.

With reference to FIG. 6, each hanger bar magazine 20 supplies a conventional hanger or cathode bar 21 to a yoke 22a at the outer end portion of radial arm 22 of each of counterrotating four arm wheels 23 and 24. Hanger bar 21 is supplied to each yoke with the yoke in open position and after the supply of bars 21 to the yokes, the yokes are closed in conventional manner so as to retain the hanger bars therein. Hanger bars extend a short distance beyond the side surface plane of each of radial arms 22 while retained by the yokes.

When wheel 23 is clockwise rotating and wheel 24 is rotating counterclockwise and at substantially the same velocity as wheel 23, each bar 21 retained in the arm yokes collects a loop 25 of copper from each loop magazine 26. Each loop is a strip or band of copper of typical dimensions hereinbefore disclosed and is pre-bent in loop or generally loop form. "Mother" blanks 27 having "daughter" sheet copper electrodeposits on the blank's opposite faces are supplied separately and at an appropriate velocity by a conventional moving rack 28 downwardly between the narrowly spaced apart radial arms 22 of wheels 23 and 24. Prior to being supplied between radial arms 22, the "mother" blanks with their "daughter" electrodepositions are manually inspected and any "mother" blanks having faulty electrodepositions, or required for loop production by cutting of their "daughter" electrodepositions, are marked in any suitable manner, for instance by attaching a clothes peg-type clip thereto. The velocity of downward movement of the "mother" blank with their "daughter" sheet electrodepositions is synchronized or correlated with the velocity of rotation of radial arms 22 of wheels 23 and 24 in such fashion that the loops 25 are supplied to the lower end portions of the "mother" blank 27 to enable the loops to be welded to the "daughter" sheet copper electrodepositions on the opposite faces of the mother blank and at the lower portion of the "daughters." Prior to reaching the welding stations hereafter disclosed for welding of the loops thereto, those "mother" blanks which are marked by having the clothes peg-type clip attached thereto or in other suitable manner, are withdrawn from the rack as one conventional single stripper can be utilized to strip the "daughter" electrodepositions from these withdrawn "mothers."

At welding stations 29 and 30, the loops are welded to only that face or side of the "daughter" sheet copper electrodeposition not in contact with or farthest removed from the main depositing surface of the "mother" blank, by means of conventional welding machine 31 and 32, such as a stud spray arc welding machine, and a substantially pure copper filler wire applied through registered pre-punched spaced holes previously mentioned herein in the end portions of the arms of copper loops 25. Care is exercised during the welding not to damage the "mother" blank. The welding of the loops, preferably two per each daughter sheet electrodeposits, takes place simultaneously and requires only a very short time, typically 0.5 second.

With wheels 23 and 24 continuing their clockwise and counterclockwise rotation respectively, and with "mother" blank 27 continuing to move downwardly at an appropriate speed with loops 25 welded to its "daughter" electrodepositions, hanger bars 21 inserted through the loops 25 initiate the drawing or peeling of the "daughter" sheet electrodepositions 37 evenly away from the "mother" blanks 27 in the incipient stripping zone. Designating the "mother" blank 27 minus the stripped "daughters" then passes between the elements of a conventional thickness sensing device (not shown) to assure that stripping has been properly effected, after which the "mother" descends into a conventional coating tank 34 wherein it is coated by sideways movement therein with an oil-in-water emulsion 35. The "mother" blank is then lifted out of tank 34 through squeegees 36, which remove excess emulsion and transferred to the return racks (not shown).

The "daughter" sheet copper electrodepositions 37, after being stripped or peeled completely off the "mother" blank 27 by the action of the hanger bars 21 engaging the loops 25 welded thereto, tend to be wavy due to the stripping action. To flatten the "daughter" sheets 37, they are passed into a conventional press 38 comprising pivotally-mounted press members 39. Press members 39 are in a substantially horizontal "open" position to receive the "daughter" sheets 37, move upwardly to a vertical position and closely adjacent one another with the "daughter" sheet between them to flatten the wavy "daughter" sheet, and again pivot downwardly to a generally horizontal position to release the flattened "daughter" sheet 37 and to receive another "daughter" sheet.

The "daughter" sheet electrodepositions 37 are then moved in an arcuate upward direction until they approach close to storage racks 40. The yokes 22a which secure the hanger bars 21 and the "daughter" sheets 37 depending therefrom, are then opened in conventional manner and the
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"daughters" or starting sheet loop assemblies are moved onto storage racks 40 manually or in any other suitable manner. These copper starting sheet loop assemblies are utilized as such to provide the cathode starting sheets in the electrorefining tank or electrowinning tank. The corresponding arm of wheels 23 and 24 then moves arcuate and upwardly with yoke 22a open to receive another hanger bar 21 from magazine 20, and the cycle is repeated.

As the welded loops contact the "daughter" electrodeposits only on that face thereof farthest removed from the "mother" blank, there will be a tendency for the stripped "daughter" cathode starting sheets to hang by their loops in the electrolyte tank at a slight angle from the vertical. This may be overcome by slightly bending or kinking the stripped "daughter" sheets at the upper portion thereof.

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 or equivalents, various omissions, substitutions and changes may be made by those skilled in the art without departing from the spirit of the invention.

What is claimed is:

1. A starting sheet blank-removable sheet metal electrodeposit assembly comprising the starting sheet blank metallic plate having at least one main depositing surface, a sheet metal electrodeposit on the main depositing surface, for rendering the sheet electrodeposit separable along edge portions of said blank metallic plate, and at least one loop attached to the sheet metal electrodeposit, the bond of attachment of the loop to the sheet metal electrodeposit being of strength sufficient to enable stripping removal of the sheet electrodeposit from the main depositing surface by means of the loop.

2. The assembly of claim 1 wherein the starting blank metallic plate, the sheet metal electrodeposit, and the loops are of copper, the attachment of the loop to the sheet metal electrodeposit being by welding.

3. The assembly of claim 2 further characterized by a hanger bar inserted through the loop welded to the copper sheet metal electrodeposit.

4. The assembly of claim 3 wherein the copper loop is welded to the copper sheet metal electrodeposit by substantially pure copper applied in molten state to substantially pure copper filler wire inserted through registering pre-punched holes in opposite end portions of the loop.

5. The assembly of claim 3 wherein the copper loop is welded to a lower portion of the sheet metal electrodeposit.

6. A starting sheet blank-removable sheet metal electrodeposit assembly comprising the starting sheet blank metallic plate having two main depositing surfaces, a sheet metal electrodeposit on each main depositing surface, means for rendering the sheet electrodeposit separable along edge portions of said blank metallic plate, and at least two spaced apart loops attached to that side only of each sheet metal electrodeposit farthest removed from the plate depositing surface, the bond of attachment of the loops to each sheet electrodeposit being of strength sufficient to enable stripping removal of the sheet metal electrodeposits from the main depositing surfaces by means of the loops.

7. The assembly of claim 6 further characterized by means on each main depositing surface for facilitating separation of the sheet metal electrodeposit from said depositing surface.

8. The assembly of claim 6 wherein the starting blank metallic plate, the sheet metal electrodeposits, and the loops are of copper, the attachment of the loops to the sheet metal electrodeposits being by welding.

9. The assembly of claim 8 further characterized by a hanger bar inserted through the loops welded to each copper sheet metal electrodeposit.

10. The assembly of claim 9 wherein the copper loops are welded to the copper sheet metal electrodeposits by substantially pure copper applied in molten state in an inert gas envelope from substantially pure copper filler wire inserted through registering pre-punched holes in opposite end portions of the loops.

11. The assembly of claim 10 wherein the pre-punched holes are only partially pierced through the loops opposite end portions, and a generally horizontal lip extends outwardly from the bottom portion of each hole, whereby retention of molten copper weld metal in the holes is facilitated during the welding.

12. The assembly of claim 9 wherein the copper loops are welded to a lower portion of the sheet metal electrodeposit.

13. A method for effecting the stripping removal of a sheet metal electrodeposit from the starting sheet blank-removable sheet metal electrodeposit assembly of claim 1, which comprises applying a pulling force to the sheet metal electrodeposit sufficient to separate the electrodeposit from and draw said electrodeposit away from the main depositing surface of the starting sheet blank, the pulling force being applied to the sheet electrodeposit by means of the one or more loops attached to the electrodeposit.

14. The method of claim 13 wherein the pulling force is applied to the sheet metal electrodeposit with the aid of a hanger bar inserted through the one or more loops attached to the electrodeposit.

15. A method for effecting the stripping removal of a sheet metal electrodeposit from the starting sheet blank-removable sheet metal electrodeposit assembly of claim 2, which comprises applying a pulling force to the sheet metal electrodeposit sufficient to separate the electrodeposits from and draw said electrodeposits away from the main depositing surfaces of the starting sheet blank, the pulling force being separately applied to the sheet electrodeposit by the loops attached to each electrodeposit.

16. The method of claim 15 wherein the pulling force is applied to the sheet metal electrodeposit with the aid of a hanger bar inserted through the loops attached to each electrodeposit.

17. A method for effecting the stripping removal of a sheet copper electrodeposit from a copper starting sheet blank, which comprises attaching at least one loop to the sheet copper electrodeposit on the starting sheet blank, and thereafter applying a pulling force to the sheet copper electrodeposit sufficient to separate the electrodeposit from and draw said electrodeposit away from the main depositing surface of the starting sheet blank; the pulling force being applied to the sheet copper electrodeposit by means of the one or more loops attached to said electrodeposit.

18. The method of claim 17 wherein the at least one loop is attached to the sheet copper electrodeposit by welding with substantially pure copper from substantially pure copper filler wire applied in molten state through registering pre-punched holes in opposite end portions of the loop.

19. The method of claim 18 wherein the pulling force is applied to the sheet copper electrodeposit with the aid of a hanger bar inserted through the one or more loops welded to the electrodeposit.

20. A method for effecting the stripping removal of a sheet copper electrodeposit from a copper starting sheet blank which comprises attaching at least two loops to a lower portion of a sheet copper electrodeposit on each of two main depositing surfaces of the starting sheet blank, and thereafter separately applying a pulling force to each sheet copper electrodeposit to thereby separate the sheet electrodeposits from and draw said electrodeposits away from the starting sheet blank main depositing surfaces, the pulling force being applied to the electrodeposits by means of the loops attached to each electrodeposit.
21. The method of claim 20 wherein the loops are attached to each sheet copper electrodeposit by welding with substantially pure copper from substantially pure copper filler wire applied in molten state through registering pre-punched holes in opposite end portions of each loop.

22. The method of claim 21 wherein the pulling force is separately applied to the sheet copper electrodeposit with the aid of a hanger bar inserted through the loops welded to each electrodeposit.

23. The method of claim 20 further characterized by flattening each sheet copper electrodeposit after its separation and withdrawal from the starting sheet blank.