April 19, 1949. W. L. PINNER 2,467,852

ELECTROLYTIC SHEET METAL ANODE

Filed March 23, 1944

Fig. 1.

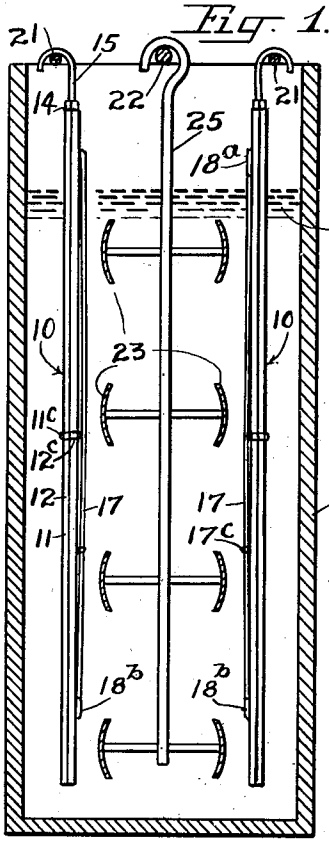


Fig. 2.

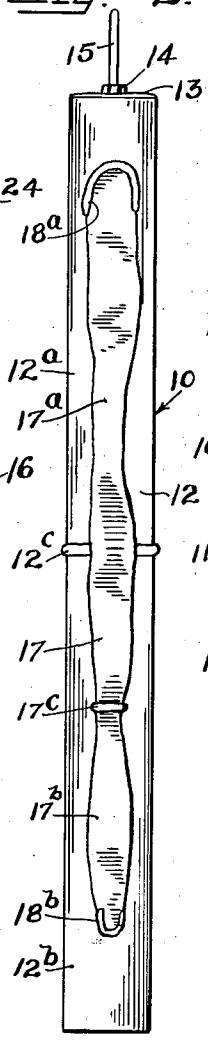


Fig. 3.

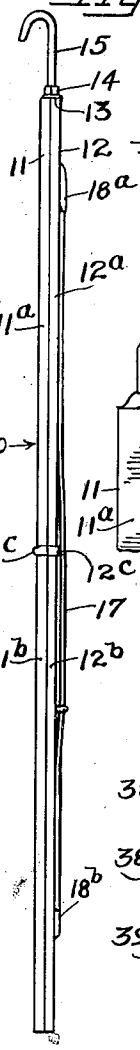


Fig. 4.

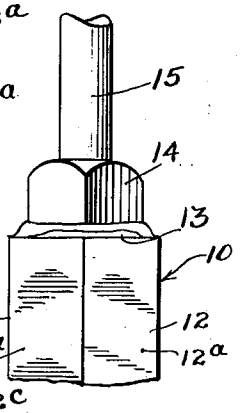


Fig. 5.

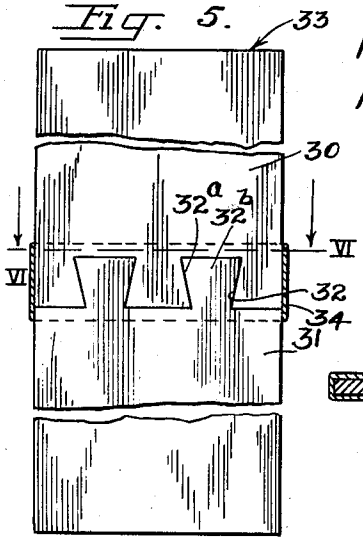


Fig. 6.

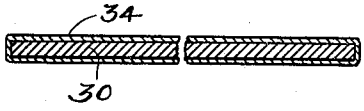
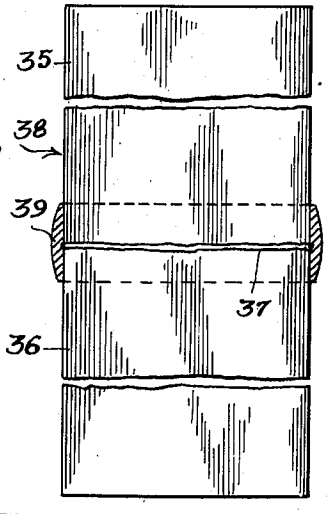


Fig. 7.



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ELECTROLYTIC SHEET METAL ANODE

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3 Claims. (Cl. 204—290)

1

This invention relates to an electrolytic sheet metal anode for use in the electrodeposition of the metal forming the anode. The invention pertains particularly to long composite anodes formed of electrolytic nickel sheets.

In the electrodeposition of nickel, it has been customary to employ rolled or cast nickel sheets, in spite of the lower cost per pound of electrolytic nickel. Although electrolytic sheet nickel is obtainable in the open market in lengths up to 36 inches, such short lengths of electrolytic sheet nickel have not been generally used as anode material even where long anodes are not required.

Electrolytic sheet nickel may satisfactorily be substituted for rolled or cast nickel as anode material for nickel-plating. However, when two electrolytic nickel sheets are joined together end to end, to form anodes longer than 36 inches, such as are required in large industrial nickel-plating operations, the resulting joint is preferentially attacked when the composite anode is exposed to corrosion in a plating tank, so that the lower sheet falls off long before the composite anode has been reduced to scrap by corrosion. Whether the joint is formed mechanically, as by employing a dovetail join between the anode sheets, or by riveting, or by welding, the joint is in all cases subjected to preferential electrolytic attack.

I have now found that either a mechanically formed joint or a welded joint may be shielded against preferential electrolytic attack in any of several ways. The joint may, for instance, be temporarily protected by providing a relatively non-porous and non-conductive layer or coating over the joint, such, for instance, as an elastic rubber band. After the anode has been in use for some time, corrosion will have progressed sufficiently far to permit the removal of the rubber band or other shielding means without bringing about any excessive subsequent attack on the joint.

According to another phase of my invention, instead of completely protecting the joint against preferential electrolytic attack, the joint may be shielded against excessive electrolytic attack so as to retard the corrosion or undercutting of the joint sufficiently that it will not catch up with the corrosion of the lower half of the welded composite anode until after the shielding means itself has been consumed. In this case, the shielding means may suitably comprise anode scrap that has been attached lengthwise to the composite anode in such manner as to overlie and partially cover that side of the joint in the composite anode facing the work, or cathode.

2

For instance, if the composite anode comprises electrolytic nickel sheets welded together end to end, one or more scrap nickel anodes may be attached lengthwise, as by welding at their ends, so as to overlie the joint in the composite sheet nickel anode. The scrap nickel anode, being thus subjected to preferential electrolytic attack, retards the corrosion of the main welded joint between the electrolytic nickel sheets so much that it will not catch up with the corrosion of the lower half of the welded anode until after the scrap anode has been consumed. In this way, the lower half of the welded anode will not drop off before the anode has corroded so far as to render it inoperative and fit only for scrap.

It is therefore an important object of the present invention to make available electrolytic metal sheets, and particularly electrolytic nickel sheets, in lengths greater than those formerly available on the market, so that the same can be efficiently used in the electrolytic deposition of the metal of which the electrolytic sheets are formed.

It is a further important object of this invention to make available electrolytic metal sheets, and particularly electrolytic nickel sheets, in the form of relatively long composite panels, joined together through the metal of the sheets themselves, with the joints shielded from preferential electrolytic attack during use.

It is a further important object of this invention to provide a relatively long composite welded electrolytic nickel sheet anode formed from electrolytic nickel sheets not available in the lengths desired and provided with means for shielding the welded joints against preferential electrolytic attack when the anode is in use and the welded joints are immersed within an aqueous plating bath.

Other and further important objects of this invention will be apparent from the disclosures in the specification and the accompanying drawings, which show composite metal anodes embodying the present invention.

On the drawings:

Figure 1 is a vertical transverse sectional view through a nickel plating tank showing composite nickel sheet anodes embodying my invention disposed in position for plating.

Figure 2 is a front elevational view of a composite nickel sheet anode according to this invention.

Figure 3 is a side elevational view of the anode of Figure 2.

Figure 4 is an enlarged, fragmentary view of

the composite metal anode of Figures 2 and 3, showing the top of the anode with the suspending hook broken away.

Figure 5 is a broken elevational view, with parts in section, of a modified form of my composite sheet metal anode.

Figure 6 is a sectional view taken substantially along the line VI—VI of Figure 5.

Figure 7 is a broken, elevational view, with parts in section, of a further modified form of my composite sheet metal anode.

As shown on the drawings:

In Figures 1 to 4, inclusive, the reference numeral **10** indicates generally a composite sheet metal anode embodying the principles of this invention. In the preferred form of my invention, the composite metal anode is formed of a plurality of sheets of electrolytic nickel, but it will be understood that electrolytic sheets of other metals, such as copper, may be used in forming the composite anodes hereinafter described.

The composite anode **10** is preferably formed of a pair of panels **11** and **12**, each of which comprises a pair of electrolytic nickel sheets, such as the sheets **11***a* and **11***b* and the sheets **12***a* and **12***b* (Fig. 3). Each of said nickel sheets **11***a*, **11***b*, **12***a* and **12***b*, may be such as are ordinarily available from the refinery in lengths up to thirty-six inches. The individual sheets are then joined in pairs to form the panels **11** and **12** and the panels are joined together at their upper edges for connection to a suspending means, thereby making a composite anode of the desired length where such length is longer than thirty-six inches.

More particularly, each of the pairs of sheets **11***a* and **11***b*, and **12***a* and **12***b*, are joined together in end-to-end relationship by means of welds **11***c* and **12***c*, and the two panels **11** and **12** thus formed are superimposed on each other and connected together at one end by a weld **13**. Thus, for instance, if the sheets **11***a*, **11***b*, **12***a* and **12***b* are 32 inches long and 4½ inches wide, the anodes formed from these sheets will be 64 inches long and 4½ inches wide and will contain two thicknesses of electrolytic sheet nickel. Anodes of lengths other than 64 inches but longer than **36** inches may be similarly formed.

The weld **13** preferably joins the upper edges of the two sheets **11** and **12**, the lower edges of which are joined by separate welds **11***c* and **12***c* to the lower sheets **11***b* and **12***b*, respectively. As best shown in Figure 4, the weld **13** is also utilized to attach to the composite anode a nut **14**, into which a terminally threaded hook **15** may be screwed. The hook **15** enables the composite sheet anode to be suspended from a bus bar, or other conductor of electrical current, for immersion of the anode in the electrolyte of the plating bath. When the anode is immersed, the welds **11***c* and **12***c* are, of course, submerged below the surface of the electrolyte. This is best illustrated in Figure 1, where the reference numeral **16** indicates a plating tank, provided with anodic bus bars **21** and a cathodic bus bar **22**. Articles to be plated, such as the articles **23**, are suspended below the surface of the plating bath **24** by means of a rack **25** depending from the cathodic bus bar **22**.

If a composite anode were formed only of electrolytic nickel sheets welded together and then used without any provision for protecting the submerged welded joint, such as the welds **11***c* and **12***c*, the lower nickel sheets **11***b* and **12***b* would fall off before the anode as a whole had been reduced to scrap dimensions. This is because the metal around the welds, due to the heat treatment caused by the welding operation, corrodes more rapidly than the rest of the metal of the anode. Consequently, if unprotected, the welds would be corroded most rapidly and fail, letting the lower portions, such as the sheets **11***b* and **12***b*, fall off into the plating bath.

To avoid too rapid corrosion of the submerged welds **11***c* and **12***c*, I attach to the composite anode **10**, in front of the anode face that is to be turned toward the cathode, such as the articles **23**, a piece of nickel that at least partially covers the welds **12***c* and **11***c* that are to be protected. A corroded anode reduced to scrap dimensions may advantageously be used for this purpose. In Figures 1 to 3, inclusive, such a scrap anode is indicated by the reference numeral **17**, and is shown attached to the composite anode **10** at its upper and lower ends by welds **18***a* and **18***b*, respectively. The upper weld **18***a* is preferably at such a point as to be above the level of the bath **24** when the anode is in use.

When the welded composite anode **10** is thus provided with the scrap anode **17**, the welds **12***c* and **11***c* are protected against too rapid corrosion until the scrap anode **17** has been consumed so far as to completely expose the weld **12***c*. By that time, however, the corrosion or undercutting of the weld **12***c* can no longer catch up with the corrosion of the lower sheet **12***b* of the panel **12**, and the same is also true of the other panel **11** since the weld **11***c* of that panel is protected both by the scrap anode **17** and also by the panel **12** that lies toward the cathode. Consequently, the lower sheets **12***b* and **11***b* are largely, or completely, consumed before the welds **12***c* and **11***c* are corroded sufficiently far to give away.

The application to the face of the composite sheet nickel anode of anode scrap, so as to cover the submerged weld at least partially, thus retards the preferential attack of the electrolyte of the bath **24** on the metal of the weld. Were it not for this retarding or protecting action against the action of the electrolyte, the metal of the welds, or the heat treated metal contiguous to the welds, would tend to be attacked preferentially or more rapidly than the metal of the anode sheets proper. This is true even where the metal of the welds is the same metal, namely nickel, as the metal of the electrolytic sheets.

The scrap anode **17** illustrates the condition of an anode according to this invention when corroded to scrap dimensions. Originally the anode **17** was a full-size composite anode like the anode **10** described hereinabove. Corrosion consumed the first layer of nickel sheets, leaving the second layer in the condition illustrated at the time the anode had to be scrapped. It will be noted that the weld **17***c* joining the two electrolytic metal sheets **17***a* and **17***b* has not been corroded or undercut enough to permit the lower sheet **17***b* to drop off. On further corrosion of the scrap anode **17**, the lower sheet **17***b* would be consumed entirely, and would not fall off, since the metal is by then sufficiently porous to corrode as rapidly as the welded joint **17***c*.

In place of using two thicknesses of panels, such as panels **11** and **12**, each composed of separate sheets joined end-to-end, it is, of course, possible to use a single thickness panel or to unite more than two panels together. The upper and lower edges of the superimposed panels may be welded together, or only the upper edges need be welded. The protective scrap anode may ex-

tend over more or less of the length of the composite anode, and may cover the weld or welds to be protected more or less completely. More than one scrap anode may be affixed to the composite anode, and if a plurality of scrap anodes are thus attached, the scrap anode may be arranged in the manner of shingles, one end only being welded to the anode proper and that welded end being covered by an overlying piece of scrap anode.

The anodes of this invention may thus be characterized as comprising sheets of electrolytic nickel joined end-to-end through the metal of the sheets, as by welding, and having on that face turned toward the cathode at least one piece of nickel smaller than the composite anode in surface area and covering the weld, or welds, at least partially. This smaller piece of nickel protects the weld and adjoining parts of the virgin nickel sheets by being consumed preferentially, so as to give the normal corrosion of the anodic nickel sheets a head start over both the corrosion of the weld material and of the metal contiguous thereto. If two thicknesses of sheet nickel are provided, the first thickness, having been protected by a scrap anode, will in turn protect the second thickness, or second panel, when after complete consumption of the scrap anode, corrosion of the first thickness, or panel, exposes the second panel to corrosion. In this manner, practically all of the electrolytic nickel used for anodes is consumed, and less scrap nickel is left to be disposed of by sale or otherwise.

In the modified form of my invention, illustrated in Figures 5 and 6, a pair of electrolytic nickel sheets, such as the sheets 30 and 31, are joined together by a mechanical joint, such as the dovetail joint 32. For this purpose, the end of the sheet 30 may be formed with a reentrant type of groove or recess 32*a*, while the end of the sheet 31 is formed with a similarly contoured tongue 32*b* adapted to mate with the groove 32*a*. There is thus produced a panel 33 which may be used like the panels 11 and 12 for building up a composite anode.

If a panel such as the panel 33 were used without any provision for protecting the joint 32 against attack by the electrolyte during the plating operation, the joint 32 would be likely to fail before the anode as a whole had been reduced to scrap dimensions. Upon failure of the joint, the lower sheet 31 would drop off into the plating tank before giving maximum service, thereby giving rise to a large scrap figure and to poor plating. The reason for failure at the joint 32 is that the attack of the electrolyte is concentrated at the edges formed by said joint, so that the corrosion is more rapid at that point. This is a different reason than that given in connection with the welded type of anode previously described, where the welded joint corrodes much faster than the un-heat-treated metal in the body of the anode.

According to my present invention, I provide a relatively non-porous and non-conductive layer or coating over the joint 32 to protect temporarily, or as long as necessary, against excessive electrolytic attack and resulting corrosion. For this purpose, an elastic rubber band 34 is stretched and slipped over the joint 32 to overlie all of the edges forming such joint. A composition of rubber is selected that is known to be resistant toward the action of the particular electrolyte with which the anode panel 33 is to be used.

When the panel 33 is made up into a composite sheet metal anode, like the anode 10 above described, the joint 32 is, of course, submerged in the electrolytic bath 24. During the operation of the plating bath the rubber band 34 protects the joint 32 against excessive corrosion due to electrolytic attack. After the anode has been in use for a longer or shorter time, corrosion of the sheets 30 and 31 will have progressed sufficiently far to permit the removal of the rubber band 34 without bringing about any excessive subsequent attack on the joint 32. In this way excessive preferential attack of the joint 32 is retarded in order that the maximum consumption of the metal of the sheets 30 and 31 can be realized.

Figure 7 illustrates a still further modification of anode construction. As there illustrated, a pair of electrolytic nickel sheets 35 and 36 are joined together by a weld 37 in end-to-end relationship to form an elongated panel 38. A strip of lead 39 is then wrapped around the welded joint 37 to protect the same against preferential electrolytic attack during use of the panel 38 in a composite anode such as already described. The lead strip 39 thus may serve the same function as the rubber band 34. The use of a lead strip in a nickel plating bath would produce no harmful result where the bath is of the low chloride type, containing for instance less than 75 grams per liter of nickel chloride ($NiCl_2$ $6H_2O$), or where the baths are not of the oxidized type that produce nascent chlorine.

A lead strip such as the lead strip 39 may also be used with the mechanical type of joint such as the joint 32 illustrated in Figure 5. Other types of mechanical joints than the dovetail joint 32 may also be employed. This type of joint has been found, however, to be very satisfactory, since the mating tongue and groove can be cheaply formed in a punch press and the mating portions so formed then forced together in a press to provide a good electrical joint through the metal of the sheets themselves. It is not necessary that a dovetail joint be employed since any joint providing good structural and electrical contact, and capable of being blocked off or shielded from preferential electrolytic attack, will serve equally well.

In place of using a non-porous and non-conductive material such as rubber for overlying the mechanically formed or welded joints, plastic compositions of the bakelite or other synthetic resin type, a "stop-off" lacquer, or the like, a vitreous ceramic material, or even glass, may be used, but where this type of protection is used, I prefer to employ bands of rubber or rubber composition since they may be so easily slipped on and off.

The provision of a composite sheet metal anode, such as the anode 10, makes possible the use of electrolytic metal sheets in anodes of any desired length and weight. The composite anodes may thus be made to weigh the same as a cast or rolled metal anode to the same length. This means that it is unnecessary to replace the composite sheet metal anodes of my invention any more often than in the case of rolled or cast metal anodes of the same weight.

This application is a continuation-in-part of my applications Serial Numbers 307,403, filed December 4, 1939 and 413,249, filed October 2, 1941 which have now become abandoned.

It will, of course, be understood that various details of construction may be varied through a wide range without departing from the principles

of this invention and it is, therefore, not the purpose to limit the patent granted hereon otherwise than necessitated by the scope of the appended claims.

What I claim is:

1. A composite metal anode for use in the electrodeposition of the metal of which said anode is formed, which comprises a plurality of sheets of electrolytic metal, pairs of said sheets being joined together lengthwise through the metal of the respective sheets to form elongated panels and the panels being connected along their upper edges, a suspending member secured to said connected upper edges, and means temporarily protecting the joined together portions of said panels from electrolytic attack during the early stages of the use of said anode in electrodeposition work.

2. A composite metal anode for use in the electrodeposition of metal of which said anode is formed, which comprises a plurality of sheets of electrolytic metal, pairs of said sheets being joined together lengthwise through the metal of the respective sheets to form elongated panels and the panels being connected along their upper edges, a suspending member secured to said connected upped edges, and means temporarily protecting the joined together portions of said panels from electrolytic attack during the early stages of the use of said anode in electrodeposition work, said protecting means including a non-porous, non-conductive material over-lying the joined together portions of the panels to shield the joint against attack by an electrolyte to which it is subjected during electrodeposition work.

3. A nickel anode comprising two superimposed layers of electrolytic nickel sheets, the sheets of each layer being welded together end-to-end and the two layers being welded together at their top edges, suspending means attached to said welded top edges and electrolytic nickel anode scrap welded to an exposed face of one of said layers to overlie the weld and to cover at least part of the width of said weld between the ends of the sheets of said layer.

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