March 7, 1961 E. R. RAMIREZ ET AL 2,974,097

ELECTROLYTIC MEANS FOR TREATING METAL

Filed Nov. 12, 1957

FIG. 1.

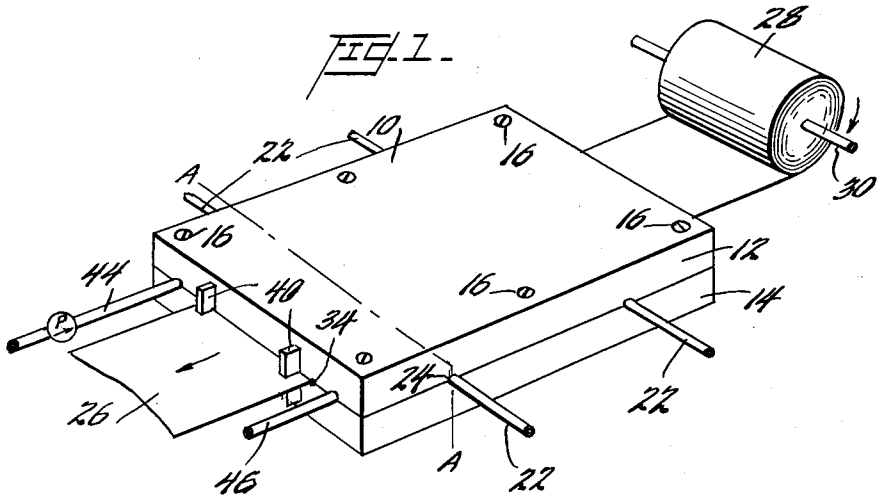
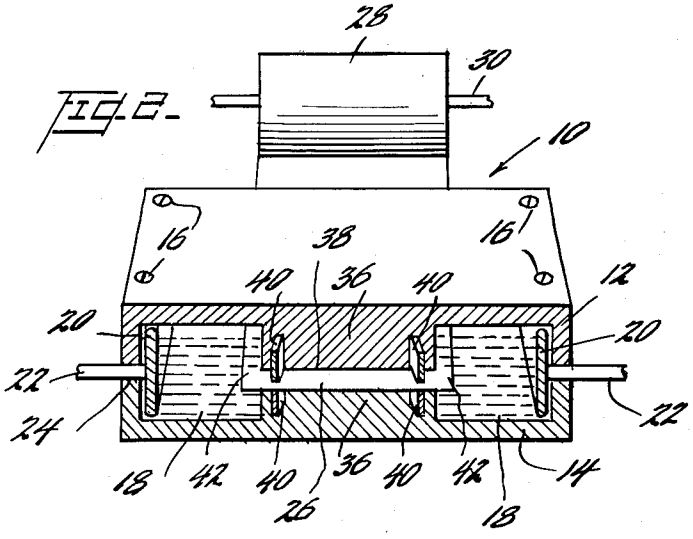


FIG. 2.



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United States Patent Office 2,974,097 Patented Mar. 7, 1961

2,974,097

ELECTROLYTIC MEANS FOR TREATING METAL

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Filed Nov. 12, 1957, Ser. No. 695,901

4 Claims. (Cl. 204—206)

This invention relates to a novel apparatus and method for the electrolytic treatment of the edge portions of a flexible metal web, such as metal strip or foil. More particularly, the invention concerns an apparatus and method for the edge anodizing of aluminum strip or foil in thin gages.

In many industrial applications in which metal strip or foil is used, it becomes necessary to subject the edge portions to special types of electrolytic pretreatments or after-treatments. Examples of such electrolytic treatments include the removal of burrs, protuberances, and slivers from the edges of metal webs which have been produced by slitting or shearing, as well as edge electroplating operations in the manufacture of blanks for can bodies. Where the metal in question is aluminum strip or foil, which is to be used, for example, in electrical windings for transformers or other electrical devices, the removal of burrs and protuberances is a necessity in order to avoid subsequent short circuits, punctures, and the like when the aluminum is converted into electrical windings. Moreover, for certain types of applications, it is desirable that an oxide coating be established over the surfaces of the aluminum strip or foil, and in such cases, it is highly desirable that a localized precoat of oxide along the edges of the material be first produced along the edges of the aluminum, to be followed thereafter by overall anodizing. The production of such a precoat of oxide by a type of edge anodizing is described in our copending application Serial No. 688,669, filed October 7, 1957.

Up to the present time, there has not been available any type of equipment which would permit electrolytic edge treatment of metal strip or foil by other than unsatisfactory and time consuming batch methods. Thus, apparatus is known for continuous over-all plating or etching of metal webs, but no practical means is disclosed in the prior art for confining the action of the treating baths to the edge portions.

In connection with the preparation of can blanks, for example, apparatus is known for immersing edge portions of back plate in a series of successive treating baths, but this apparatus and method is not adaptable to either batch or continuous operation with long webs of metal, particularly of metal in thin gages.

Similarly, mechanical methods of removing edge burrs and protuberances in the case of aluminum strip are unsatisfactory when dealing with thin gages such as those in the range of 0.004" to 0.008".

In accordance with the present invention, there is provided an apparatus or device for either continuous or batch electrolytic treatment of metal strip or foil which is adaptable for edge conditioning, edge plating, edge anodizing, or similar types of treatments in which the electrolytic action is confined to the edges of the metal, leaving the central areas unaffected.

In the apparatus of this invention means are provided for passing a flexible web of metal strip or foil, which itself constitutes an electrode, through an electrolytic bath contained within a chamber provided with another electrode or set of electrodes disposed opposite the edge or edges to be treated, and having sets of impervious resilient material, in contact with said metal web so as to seal off the central portions of the metal and to prevent access of the bath thereto.

In accordance with the present invention there is also provided a novel method for the continuous edge electrolytic treatment of flexible metallic webs, such as strip or foil, whereby the treating electrolyte is permitted to come into contact only with the edges of the metal and areas immediately contiguous thereto. The method is illustrated by examples of the edge conditioning and edge anodizing of aluminum strip or foil in thin gages, but in its broader aspects it is applicable to similar operations and on other metals.

For a better understanding of the invention and its purposes, advantages, and details, reference is now made to the present preferred embodiment of the invention which is shown, for purposes of illustration only, in the accompanying drawing.

In the drawing:

Fig. 1 is a perspective view of the exterior of the electrolytic treatment apparatus;

Fig. 2 is a view in cross section along the line A—A of Fig. 1 of the electrolytic treatment apparatus.

The component parts of the preferred embodiment of the electrolytic treatment apparatus comprising the present invention may be comprised of various kinds of materials, provided that these materials are resistant to the action of the chemicals used in the electrolytic bath. Hereinafter, the apparatus will be described in connection with the edge conditioning or edge anodizing of a web of aluminum metal of thin gage, although it is to be understood that the device may be utilized for other purposes where it is desired to apply electrolytic treatment to one or both edges of a flexible metal strip or foil.

As shown more particularly in Figs. 1 and 2 of the drawing, the apparatus comprises a vessel **10** comprising matching upper portion **12** and lower portion **14**. When the upper and lower portions are joined together by suitable fastening means **16**, such as bolts, there is formed chambers **18** which serve as containers for the electrolytic bath which normally fills said chambers nearly to the top.

Projecting into said chamber **18** and mounted on the interior wall thereof are electrodes **20**, which may be made of any suitable material, depending upon the purpose for which the device is to be utilized, and which will be immersed in the electrolyte during its operation. Conductors **22** passing through openings **24** serve to supply electric current to the electrodes **20**, from a power source not shown, said conductors being connected to the electrodes. In the form of device shown in the drawing, a set of electrodes is depicted, as well as a dual chamber, but it will be understood that if desired, the apparatus may be so constructed, for example, in order to treat but one edge of the metal, that only a single electrode, or a single electrode and a single edge of the metal are contained within a treating chamber.

The flexible metal web **26** to be treated is advantageously supplied from a roll **28**, suitably mounted on a shaft or spindle feeding means shown generally at **30**. Since the metal web is to form the other electrode, a conductor is suitably connected thereto for example by brush or sliding contact to supply current from a power source and to complete the circuit. The metal web **26** both enters and leaves the apparatus through narrow slotted portions **34**, one of which is shown at the exit end in Fig. 2, but for which a corresponding entrance slotted portion is provided, but not shown, in the opposite or entrance end of the apparatus. Metal web **26** may then

be rewound, or passed as such to a subsequent processing stage.

In the embodiment shown in Fig. 2, both the upper and lower portions of the electrolysis vessel are provided with metal web guiding means comprising a pair of opposed centrally disposed ribs 36 terminating in flat faces 38. The flat faces 38 are in juxtaposition and spaced apart to permit passage of the metal web between the faces. Supported in each rib 36 is a pair of sealing members 40, which extend outward from the faces 38 to contact the metal web 26, sealing off the central portion of the web, and leaving the edge portions 42 exposed to the action of the electrolyte. The sealing members 40 extend longitudinally of the web, and they may be made of any suitable impervious resilient material, such as natural or synthetic rubber, plastic materials, and the like.

Electrolyte is supplied to the treating vessel 10 by means of supply pipe 44 and removed through discharge pipe 46. Where circulation of electrolyte is to be maintained, for example, electrolyte fluid is supplied by suitable means such as a pump, shown generally at P.

The electrodes 20 extend longitudinally of the treatment vessel and are spaced apart from and opposite to, and extend along the line of the metal edges 42 which are to be treated. Where edge conditioning or anodizing of aluminum is to be carried out, for example, the electrodes 20 will serve as cathodes and may be made of graphite, lead, or other suitable material.

The mode of operation of the apparatus of the preferred embodiment of this invention comprises passing the metal web to be electrolytically treated from the roll 28 into the treatment vessel 10 which is maintained substantially filled with electrolyte, through entrance slot 34 and between sealing members 40. The metal web passes through the electrolyte treating chambers 18 with the edges 42 immersed in the liquid and the central area of the web sealed off from access of the electrolyte, the web emerging at the exit slot 34. The speed of the web is regulated as desired in accordance with the type of operation being carried on. An electric current, which may be either alternating or direct, is passed through the bath via electrodes 20 and the metal web. If circulation of the electrolyte is required, it is maintained by means of pump P. Operation may be either batch or continuous, in the latter case by changing rolls of metal web to afford an uninterrupted supply of metal, and by circulating fresh electrolyte into the treating chamber.

The novel continuous method for the electrolytic edge treatment of metal webs which also forms a part of this invention may be illustrated with reference to the treatment of aluminum strip or foil in thin gages, as previously defined. Our novel method for electrolytic edge treatment comprises continuously passing a web of metal in a horizontal position through an electrolytic treating bath with the edges of the web immersed in said bath, and the remainder of the web maintained out of contact with said bath. In the case of aluminum, such as thin gage aluminum, the bath is an anodizing solution such as sulfuric acid, the aluminum is made the anode, and the cathode is graphite or lead.

Thus, in edge conditioning of aluminum strip or foil, burs or protuberances may be removed by using as the electrolyte a hot sulfuric acid solution of from about 10 to 15 percent strength by weight, preferably about 15%. A temperature of between about 100° and 130° F., preferably about 120° F. has been found to give satisfactory results. The current density on the exposed edge portions of the aluminum is maintained at about 1,000 to 5,000 amperes per square foot, while that on the cathode is generally about one-tenth of that used on the metal edges. By maintaining the metal web with its edges below the surface of the sulfuric acid bath, while at the same time masking the central portions by suitable means such as a resilient dam in contact longitudinally with and near the edges of the strip, the acid is prevented from attacking the central portions of the web. Rounded edges are obtained which are suitable for subsequent edge anodizing.

Anodizing of the edge portions of aluminum may be performed in essentially the same manner as edge conditioning, except that the temperature of the sulfuric acid bath will generaliy be kept in the vicinity of 70° to 80° F. to permit establishment of an oxide coating the edges of the metal. Such anodizing may follow the edge conditioning, or may be carried on as a separate original operation.

While we have illustrated and described the present preferred embodiments of the invention, it will be recognized that the invention may be otherwise variously embodied and practiced within the scope of the following claims.

We claim:

1. Apparatus for the electrolytic treatment of the edge portions of a flexible metal web comprising a hollow vessel for containing electrolyte, means for supplying electrolyte to and removing it from said vessel, means for guiding said metal web through the electrolyte comprising a pair of opposing ribs terminating in flat faces spaced apart to permit passage of the metal web between them, stationary resilient sealing means mounted in said ribs extending toward and longitudinally of said metal web and adapted to maintain contact with the metal web near the edge portions thereof to confine the action of the electrolyte to said edge portions, and at least one electrode mounted in the interior of said vessel opposite the line of passage of said metal web, and means for conducting electric current to said electrode and to the metal web.

2. Apparatus for the electrolytic treatment of the edge portions of a flexible metal web comprising a hollow vessel for containing electrolyte, means for circulating electrolyte through said vessel, means for guiding the metal web through the electrolyte comprising a pair of opposing ribs centrally disposed in said vessel and mounted respectively on the upper and lower walls thereof and terminating in flat faces spaced apart to permit passage of the metal web between them, a pair of opposed stationary resilient sealing members mounted in said ribs extending toward and longitudinally of said metal web and adapted to maintain contact with the metal web near the edge portions thereof to confine the action of the electrolyte to said edge portions, a set of electrodes mounted in the interior of the vessel and opposite the line of passage of said metal web, and means for conducting an electric current to said electrodes and to the metal web.

3. Apparatus for the electrolytic treatment of the edge portions of a flexible metal web comprising a hollow vessel for containing electrolyte, means for circulating electrolyte through said vessel, means for guiding the metal web through the electrolyte so that its edge portions are immersed therein while the central area of the web remains dry comprising a pair of opposed ribs centrally disposed in said vessel along the line of passage of the web and mounted respectively on the upper and lower vessel walls and terminating in flat faces spaced apart to permit passage of the metal web between them, and pairs of stationary opposed resilient sealing members mounted in and on opposite portions of the faces of said ribs and extending between opposite walls of the vessel and toward and longitudinally of said metal web and adapted to maintain sealing contact with the metal web near the edge portions thereof to confine the action of the electrolyte to said edge portions, a set of electrodes mounted in the interior of said vessel and opposite the line of passage of the edge portions of said metal web, and means for conducting an electric current to said electrodes and to the metal web.

4. Apparatus for the electrolytic treatment of the edge portions of a flexible metal web comprising a hollow

vessel for containing electrolyte, means for circulating electrolyte through said vessel, means for feeding the metal web to said vessel, a pair of entrance and exit slots for the web in the opposite walls of the vessel, means for guiding the metal web through the electrolyte comprising a pair of opposing ribs centrally disposed in said vessel and forming extensions of the upper and lower walls thereof and terminating in flat faces spaced apart to permit passage of the web between them, pairs of stationary opposed resilient sealing members mounted in and on opposite portions of the faces of said ribs and extending toward and longitudinally of said metal web and adapted to maintain contact with said metal web near the edge portions thereof to confine the action of the electrolyte to said edge portions, flat electrodes mounted in the interior of said vessel parallel to and

opposite the line of passage of said metal web, and means for conducting an electric current to said electrodes and to the metal web.

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