June 12, 1945. F. E. DRUMMOND ET AL 2,378,002

ELECTROLYTIC APPARATUS

Original Filed Dec. 20, 1940

FIG. 1.

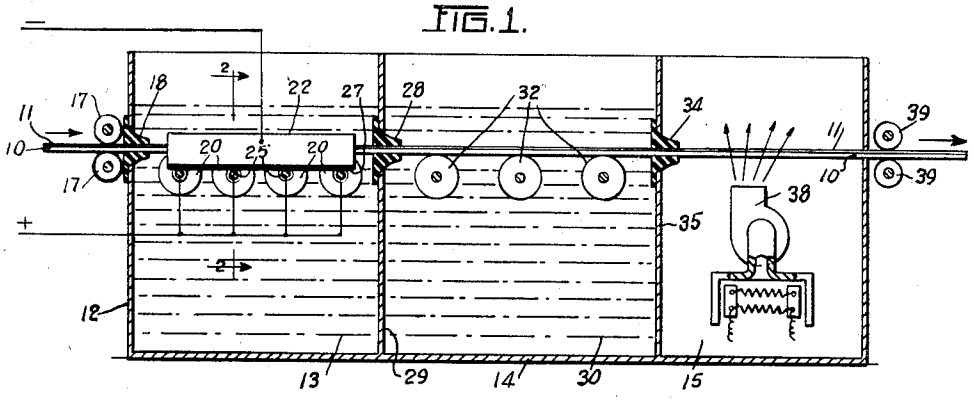


FIG. 2.

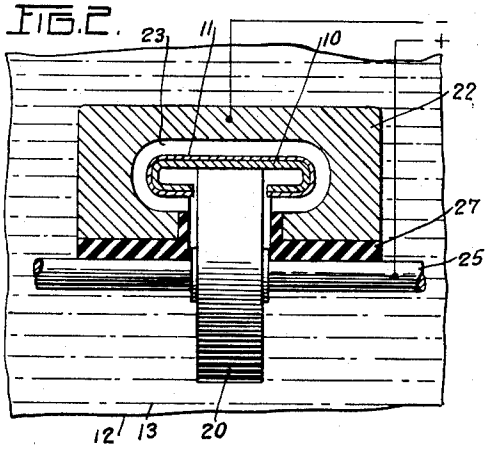


FIG. 3.

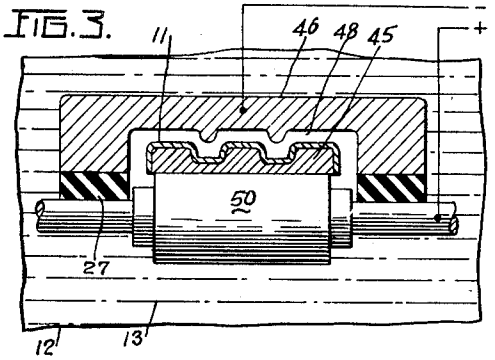


FIG. 5.

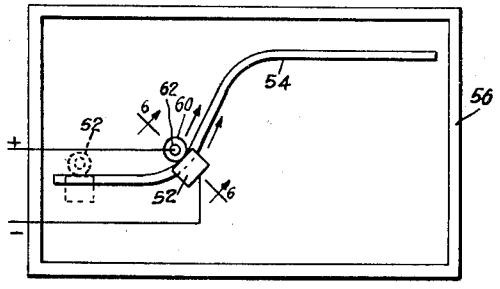


FIG. 4

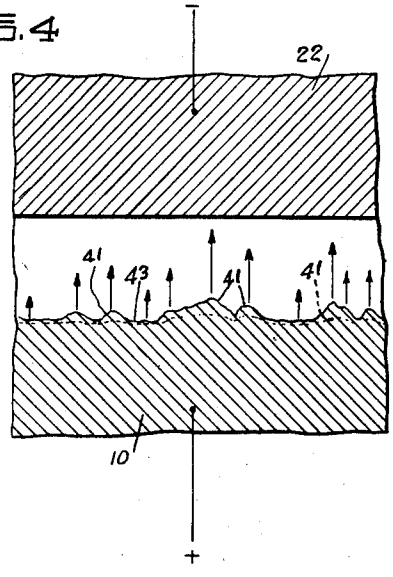
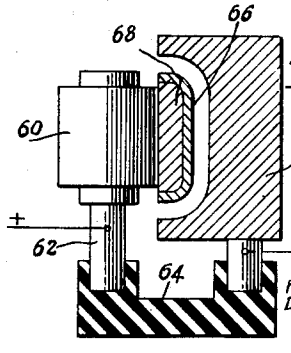


FIG. 6.



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UNITED STATES PATENT OFFICE

2,378,002

ELECTROLYTIC APPARATUS

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Original application December 20, 1940, Serial No. 370,971. Divided and this application December 13, 1941, Serial No. 422,900

3 Claims. (Cl. 204—206)

This invention relates to improvements in treating metal articles, and more particularly to apparatus for electropolishing fabricated structural members. The invention is especially adapted for finishing moulding strip material having an outer covering surface made of stainless steel or similar stainless alloy metal containing iron and chromium, or iron, chromium and nickel.

This application is a division of our copending application, Serial No. 370,971, filed December 20, 1940, which is directed particularly to the method hereinafter described. This application deals particularly with the apparatus herein described and illustrated.

It is the principal object of this invention to provide an improved method and apparatus for polishing metal electrolytically so as to produce an article having a high polish or luster without the use of mechanical polishing devices such as has been the common practice heretofore.

Another object is to devise an improved method and apparatus for manufacturing a composite sheet metal article having a surface member of light gauge or thickness which is highly polished electrolytically and presents an attractive appearance.

Another object is to provide an improved method and apparatus for producing a bright finish or structural moulding strips electrochemically and without the use of mechanical polishing devices and wherein the article may be treated while it is maintained stationary and the electrolytic polishing means passed thereover.

These and other objects and advantages will be apparent from the following description taken in connection with the drawing.

Figure 1 illustrates diagrammatically in cross section an apparatus for electropolishing a moulding strip of material such as commonly used for ornamental purposes;

Figure 2 is a fragmentary detail sectional view taken on the line 2—2 of Figure 1 and looking in the direction of the arrows;

Figure 3 is a similar view as in Figure 2 illustrating the treatment of a differently shaped two-ply structural member;

Figure 4 is an enlarged fragmentary detail sectional view illustrating diagrammatically the electropolishing action;

Figure 5 is a view illustrating schematically a modified arrangement wherein the article being electropolished is maintained substantially stationary while the electropolishing device is moved thereover;

Figure 6 is a fragmentary detail sectional view taken on the line 6—6 of Figure 5.

In general, it has been found difficult to polish stainless steel strip and similar alloy steels inasmuch as the stainless alloy material has a very low heat conductivity so that high temperatures are developed during the polishing operation which are not dissipated rapidly causing discoloration and buckling of the stainless steel strip. This difficulty has been overcome by providing the stainless steel strip with a backing member of relatively high heat conductivity whereby the heat developed during polishing is conducted away fast enough to prevent overheating the metal strip. The backing strip also provides a support for the paper-thin thickness stainless steel sheet used and permits shaping and working of the structural member into the desired form without having to contend with warping, buckling, or kinking, such as would be encountered when shaping and polishing the stainless steel sheet by itself.

The structural member may be made in various ways but preferably the two strips are simultaneously rolled or pressed together to form the composite article and thereafter subject the metal surface to electropolishing. This may be accomplished by passing the preformed structural moulding member through an apparatus such as shown in Figure 1 which illustrates one embodiment of this invention.

In Figure 1 a composite strip such as a moulding, designated 10, and preformed having a stainless steel shell 11 is advanced through the electropolishing unit 12. This unit preferably comprises three compartments 13, 14 and 15 arranged for electropolishing, rinsing and drying of the strip. Compartment 13 is a rubber or glass lined chamber in which the electrolyte is placed for treating the strip. As illustrated in Figure 1, the strip is guided into this compartment between the rolls 17, through the rubber dam 18 and into the electrolyte. The strip is anodically treated by being passed over the closely spaced anode contact rolls 20 which are arranged longitudinally along the path of the strip.

Suitable heating means may be provided for maintaining the electrolyte at the optimum temperature for effecting the electrolytic treatment. In general, the temperature of the electrolyte is held at approximately 150 degrees F. A cathode member 22 has an inner surface shape to correspond to the contour of the surface of the moulding to be polished and is placed as near to the work as possible in order to increase the ef-

ficiency of the polishing. As illustrated, the cathode comprises an elongated hollow rod which is provided with an opening 23 through which the strip material passes while in contact with the anode rolls 20. The cathode member is suitably supported on the axle shafts 25 of the anode rolls 20 and is insulated therefrom by means of the spacer block means 27. Either copper or lead may be used as the cathode material. The anode roller supporting contact members 20 may be made of stainless steel or other suitable alloy metal which does not become passive in the electrolyte. Copper or brass may be utilized if desired.

The anode and cathode members are connected to a source of electric current and the proper current density maintained as required for treating the particular structural member which is to be electropolished. The proportions and concentrations of the electrolyte and the temperature of operation, as well as current densities, may vary over a relatively wide range according to the particular metal or alloy strip material being treated. A current density of 200 to 500 amperes per square foot may be used in the treatment of stainless steel. A voltage of six to twelve volts may be employed.

The electrolytic bath may comprise a mixture of a saturated solution of potassium dichromate in strong sulphuric acid to which has been added from 5 to 25 per cent by volume of sulphonated high molecular weight alcohol, such as lauryl, cetyl and stearyl alcohol. These sulfonic acid salts have the general formula $CH_3(CH_2)_nOSO_3Na$ where n is ten or more. In some instances the electrolyte may consist of a concentrated aqueous solution of a sulphated fatty alcohol or as an alternative may be employed as a separate treatment step, depending upon the particular article being processed.

Another example of electrolyte which may be used comprises a saturated solution of potassium dichromate in sulphuric acid containing 50% by volume of phosphoric acid.

Further, as an electropolishing electrolyte for cold and hot rolled stainless steel sheet or strip of the 18–8 type use may be made of an aqueous solution of ferric sulphate and hydrofluoric acid. Ferric sulphate functions as an oxidizing agent controlling the action of the hydrofluoric to prevent etching of the surface resulting in a matte finish. The concentration of ferric sulphate and hydrofluoric acid may be varied to suit the conditions but generally a range between 5 to 15 per cent parts ferric sulphate and 1 to 5 per cent parts of concentrated hydrofluoric acid in water are preferable.

After the strip material has been anodically electropolished by subjecting it to the electrolytic treatment in compartment 13, it is drawn through the rubber dam 28 in the partitioning wall 29 and advanced through the rinsing water 30 of the compartment 14. Suitable supporting rolls 32 are provided for supporting the strip while it passes through the rinse water. Thereafter the strip is conveyed outward through the rubber dam aperture 34 in the partitioning wall 35 and passes over a hot air drier blower means 38 suitably arranged in the compartment 15. Finally the strip is conveyed between the rolls 39 and cut to the desired length or otherwise stored for shipment.

The electropolishing treatment, as diagrammatically illustrated in Figure 4, is similar to electroplating except that the flow of current is in the reverse direction. As shown, the work piece 10 is made the anode and the cathode 22 is of such a shape and area that it can be placed relatively close to the surface of the work and a concentrated anodic treatment effected so as to produce a high luster finish on the work without pitting or discoloring the work. The time required for electropolishing the work varies with the condition of the anode surface, shape and degree of polish desired, as well as the current densities employed.

During the concentrated electrolytic action on the surface of the strip being treated the peaks or raised portions 41 forming the rough surface of the work are dissolved and removed, as illustrated by the arrows in Figure 4, without undue etching or pitting of the surface. For example, the final surface plane of the article after the electrolytic treatment would conform to the dotted line shown at 41 in Figure 4. In this way, a high "anodic luster" is produced.

In Figure 3 there is illustrated a differently shaped composite structural strip 45 wherein the cathode member 46 is shaped to provide an inner contour surface 48 which coincides with the shape of the strip 45. The anode contact roll members 50 in this instance are of a width to properly support the strip 45 and a sufficient number of these anode contact rolls are provided to give the required anode area in order to effect efficient electrolytic polishing of the surface of the stainless steel.

In Figures 5 and 6 a modification is shown wherein a movable anodic electropolishing unit, generally designated 52, is provided. In this instance, where it is desired to maintain a preshaped strip or structural article 54 stationary while electropolishing the same, the article is placed in the electrolyte as in a tank or suitable compartment 56 and the anode electrode treating unit 52 moved over the strip so as to electrolytically polish the surface as desired.

The unit 52 comprises an anode contact roller 60 mounted on the axle member 62 which is fixed to the insulated supporting member 64. The member 64 likewise supports the cathode member 65 which is juxtapositioned relative to the anode roller 60 and comprises a surface contour 66 which corresponds with the surface 68 of the structural material which is to be polished. In this method the anode electrode unit 52 is moved along over the strip being treated while maintaining the anode contact roller 60 against the side of the strip which is not to be polished, or backing member in the case of a two-ply structural article, and the surface anodically treated to produce a bright surface. Suitable means may be provided for automatically advancing the electrolytic treating unit over the article to be polished and the bath may be heated by conventional means so as to maintain the same at a temperature of about 150 to 250 degrees F. This modification is adapted for producing a high polish on strips or the like articles of complicated shapes.

Although this invention is adapted for treating structural members having a stainless steel surface covering which has been previously treated to remove scale and other foreign substances, our method may be used in treating articles which have not been pretreated, since the electrolytic polishing action simultaneously removes particles of scale and similar surface contamination. However, when the scale is of such a thickness that it cannot be removed during the electropolishing treatment, it is more economical to re-

move this by the usual acid pickling treatment prior to electropolishing.

It will be understood that this invention is also adapted for use as a supplement to mechanical polishing, buffing and burnishing when desired. Further, this improved method of polishing may be utilized in treating stainless steel wire, band, sheet and spun shapes, or castings and the like, as well as multi-ply structural strip material, as illustrated in the drawing. Also various types of metals and alloys may be electropolished by our method and apparatus. Other metals than stainless steel, such as copper, brass, nickel, Monel, cobalt, zinc, tin, lead, aluminum, iron and their alloys may be electropolished by utilizing the method and apparatus of this invention.

It will be understood further that this invention is not limited to the particular electrolyte and apparatus illustrated in the drawing and that various modifications can be made by those skilled in the art without departing from the spirit and scope of this invention.

We claim:

1. An apparatus of the class described having a compartment containing an electrolyte, means for conducting and guiding a preformed structural member through said electrolyte and for making anodic contact, said guiding and contacting means comprising a plurality of rolls having axle shafts in said compartment arranged to support the preformed structural member as it passes through said compartment, a cathode member of elongated form shaped to surround said structural member and supported upon said axle shafts, and insulating means comprising a spacer block between said cathode member and said axle shafts.

2. An apparatus of the class described having a compartment containing an electrolyte, means for conducting and guiding a preformed structural member through said electrolyte and for making anodic contact, said guiding and contacting means comprising a plurality of rolls having axle shafts in said compartment arranged to support the preformed structural member as it passes through said compartment, a cathode member of elongated form having an inner surface shaped to correspond to the contour of the surface of said structural member, said cathode member supported upon said axle shafts and formed to partially surround said structural member and the upper portions of said anode rolls, and insulating material between the cathode member and said axle shafts.

3. In an apparatus for electropolishing preformed structural members: a tank containing an electrolyte; a plurality of rollers in said tank for carrying said structural members; anodically connected axle shafts carrying said rollers and being in electric conductive connection with said rollers; insulating supporting members carried by said axle shafts; cathode means supported and spaced from said anodic rollers by said insulating members, said cathode member being of elongated shape and having an inner surface shaped to correspond with the contour of said structural members.

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