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METHOD FOR ELECTROLYTIC THICKNESS REDUCTION OF METAL WIRES

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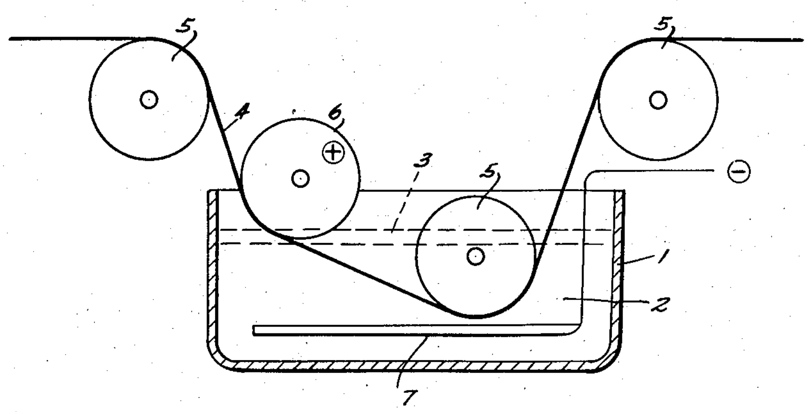

INVENTOR.
RUDOLF PALME
BY
Greene, Pineles & Durr
ATTORNEYS

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METHOD FOR ELECTROLYTIC THICKNESS REDUCTION OF METAL WIRES

Rudolf Palme, Reutte, Tirol, Austria, assignor to Schwarzkopf Development Corporation, a corporation of Maryland

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This invention relates to electrolytic reduction of the cross-section of metal wires and to methods for effecting such reduction.

In the known processes and arrangements for electrolytically reducing the cross-sections of a continuously moving wire or like wire-like metal bodies, the speed at which the process could be carried on effectively was heretofore limited by the fact that the magnitude of the electrolytic current had to be maintained below a level at which the treated wire was excessively heated.

Among the objects of the invention is an arrangement and method for electrolytically reducing the cross-section of continuously moving wires or like wire-like metal bodies at speeds much greater than heretofore possible.

The foregoing and other objects of the invention will be best understood from the following description of exemplifications thereof, reference being had to the accompanying drawing which shows diagrammatically one type of an arrangement exemplifying the invention.

It is known to reduce the cross-section of small metal wires by electrolytic removal of exterior strata thereof while the wire is drawn through an electrolytically conducting liquid or bath, and maintaining the wire at a positive voltage with respect to the electrolyte, the wire being thus the anode. The electrolyte is of such character that it removes metal strata from the wire only when a current flows between the wire and the electrolyte. Such anodic cross-section-reducing or deplating processes give not only a uniform reduction of cross-section or uniform deplating, but also give the treated wire a highly polished surface, such processes being also known as electro-polishing. Whereas reduction of the cross-section of metal bodies by chemical treatment in absence of electric current conduction is very difficult to control, electrolytic cross-section reduction of wires may be carried on with a high degree of uniformity by controlling the electric current flow between the wires and the electrolyte bath.

In the past, there was a limit to the speed at which metal wires could be reduced in cross-section by such deplating or electro-polishing process because the magnitude of the electrolytic current had to be kept below a level at which it would cause damage such as glowing or burning of the wires. With heretofore known arrangements, one of the external current supply conductors, was, as a rule, connected to the treated wire on the exterior of the electrolyte bath. A certain increase of the current flow and thereby a rise in the speed of the electro-polishing treatment could have been obtained by connecting the external current supply conductor to the treated wire within the electrolyte bath. However, with such current supply arrangement, a substantial part of the supplied current would flow directly from the current supply conductor through the electrolyte to the cathode without passing through wire and without contributing to the reduction of the cross-section of the wire. It was also difficult to find a satisfactory material for a conductor which could be connected to a part of the treated metal wire within the electrolyte, for passing current through the wire.

The present invention makes it possible to materially increase the speed at which anodic cross-section reduction of moving metal wires may be effected while eliminating the foregoing heretofore encountered difficulties. In the anodic wire-cross-section-reducing arrangement and process of the invention, these difficulties are overcome by placing or maintaining over upper surface of the electrolyte bath wherein the wire treatment is carried out a body layer of an electrically insulating liquid and connecting the current supply conductor to a portion of the treated wire which is immersed in the liquid insulating layer. Because of the cooling action of the insulating liquid layer of the invention, a much larger current may be passed through the treated wire without excessively heating or burning the wire, while eliminating any stray current flow from such supply conductor elements directly through the electrolyte to the cathode or any direct connection between such supply conductor elements and the electrolyte that would cause disturbing electrolytic actions.

By the arrangement and the method of the invention, the anodic cross-section reduction or electro-polishing treatment may be carried on with a speed at least four to five times greater than with prior art arrangement wherein the external conductor was connected to the wire in the air outside the electrolyte bath.

In accordance with the invention, a suitable insulating liquid for the superposed liquid insulating layer is one which is neutral or inert and does not mix or react with the electrolyte and which has a lower specific weight than the electrolyte. Although various insulating liquids meet this requirement, good results are obtained with insulating liquids formed of saturated hydrocarbon compositions such as saturated fractional distillates of petroleum oil.

The drawing shows diagrammatically by way of example, one form of arrangement of the invention. A suitable vessel **1** of insulating material, such as ceramic material or glass or having an inner layer of such or similar insulating material, holds a body of the electrolyte **2** above which is disposed an insulating body layer **3** of liquid petroleum. A wire **4** which is to be treated is moved at desired speed and guided over guide rollers **5**, **6**, so that a length of the wire passes along guide roller **6** through the insulating liquid body layer **3** into the electrolyte bath and is withdrawn therefrom over another guide roller **5** immersed in the electrolyte and by way of an exterior guide roller **5** to a receiving device such as receiving reel (not shown) on which it is wound. The two externally mounted guide rollers **5** are, or their outer guide surface regions are of an insulating material such as insulating synthetic resin material so that no electrically conductive connections are made between these guide rollers **5** and the portions of the moving wire **4** guided thereover. Within the electrolyte bath **2** is immersed a cathode electrode **7**, for instance, in the form of a sheet of suitable metal, which is connected to the negative terminal of a direct current supply source as indicated by the minus sign applied to an external supply lead of the cathode sheet **7**. The portion of wire **4** which is immersed in the electrolyte bath **2** operates as the anode and has connected thereto the positive terminal of the direct current source indicated by the plus sign applied to contact roller **6**. This contact roller **6** has an exterior layer of electrically conducting material which is in contact with the wire passing thereover.

With this arrangement, the wire **4** is transported and moved through the electrolyte bath **2** and the superposed insulating liquid layer **3** at the desired great speed while maintaining electrolytic current conduction between the wire **4** as an anode and the cathode **7** through the body of the liquid electrolyte **2** for electrolytically deplating or removing of exterior strata of the wire as it passes through the electrolyte 6. Since the positive supply conductor in the form of metal roller 6 makes contact with a portion of the moving wire 4 within the insulating liquid layer 3, the wire will not be excessively heated notwithstanding an increase of the electrolytic current as high as 4 to 5 times above the maximum electrolytic current that could be practically used in prior arrangement of this type.

Arrangements of the invention wherein the positive supply connection to the wire is made under a layer of insulating liquid will operate satisfactorily even with electrolytes 2 which contain additions that are to some extent or partially soluble in the insulating liquid layer 3. By way of example, good results have been obtained by carrying on electro-polishing process of the invention on a chromium-nickel steel wire with an electrolyte consisting of an aqueous solution of phosphoric acid and citric acid and an addition of ethyl alcohol. Such liquid electrolyte 2 was covered with a layer 3 of petroleum oil and the process was carried on in the manner shown diagrammatically in the drawing with high effectiveness without causing any distubing effect notwithstanding the partial solubility between the ethyl alcohol and the petroleum layer.

As another example, molybdenum wire was electro-polished with a similar arrangement and an electrolyte which contained a large proportion of methyl alcohol in a very effective way without causing any disturbance of the electrolytic action notwithstanding of the solubility between methyl alcohol and petroleum. With such arrangement, it was possible to obtain a very material increase of the speed of the wire and of the electrolytic reduction of wire cross-section and the evaporation of the methyl alcohol was retarded to such extent as to avoid the fire danger because of the relatively high inflammability of methyl alcohol vapors.

In cases where the electro-polishing process of the invention is carried on with an electrolyte bath that is maintained above the room temperature, the insulating liquid layer 3 may consist of a saturated carbohydrate substance which is solid at normal temperatures but is liquid at the operating temperature of the electrolyte bath. In this way, it is possible to use insulating layers formed of hydrocarbon compositions which have a particularly small tendency to react with the electrolyte.

The features and principles underlying the invention described above in connection with specific exemplifications, will suggest to those skilled in the art many other modifications thereof. It is accordingly desired that the

appended claims shall not be limited to any specific features or details shown and described in connection with the exemplifications thereof.

I claim:

1. The method of anodically reducing the thickness of a metal wire while moving the wire through a liquid electrolyte, the procedure comprising maintaining over the upper level of the liquid electrolyte and in contact therewith over its entire upper level a layer of an electrically insulating liquid having lower specific weight than said electrolyte, and moving said wire through said insulating liquid and said electrolyte over a rotatable metallic guide element immersed in said insulating liquid but extending in its entirety above the level of said electrolyte and over an additional guide member immersed in said electrolyte so that successive portions of said wire are continuously moved through said electrolyte, and passing current through said wire and said electrolyte from a positive pole of an electric supply source connected to said metallic guide element for electrically reducing the cross-section of said successive portions of said wire while it is being moved and guided over said metallic guide element through said electrolyte.

2. The method as claimed in claim 1, wherein the insulating liquid is a saturated hydrocarbon composition.

3. The method as claimed in claim 1, wherein the insulating liquid is a saturated hydrocarbon composition which is solid at normal temperature but which is liquid at a temperature at which current is passed through said wire and said electrolyte while said wire is moving through said electrolyte.

4. The method as claimed in claim 3, wherein said insulating liquid consists of a saturated petroleum oil distillate.

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