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METHOD OF CLEANING METAL

Christopher J. Krogel, New York, N. Y., assignor
to Western Electric Company, Incorporated,
New York, N. Y., a corporation of New York

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This invention relates to a method of treating material and more particularly to a method of treating surfaces of material, especially metallic wire to clean the surface thereof.

Metallic wire is used in the manufacture of a countless variety of products, and, generally speaking, it is desirable that foreign substances adherent to or found on the surface of the wire such as oils, greases, dust, and the like, or oxidation products, sulphides, and the like superficial corrosion products, be removed before the wire is actually put to use.

An object of the present invention is to provide a method of treating material to remove superficial foreign material and corrosion products, which method shall be simple, speedy, reliable, inexpensive and safe in operation.

With the above and other objects in view the invention may be embodied in a method of treating metallic material wherein the surface to be cleaned is immersed in a bath comprising a solution of a suitable electrolyte such as sodium orthosilicate and in particular including as a component a relatively small proportion of a foaming agent such as ordinary soap, and causing the material while in the bath to be one electrode for an electric circuit through the material and the bath, the foaming agent in the bath acting to create a floating foam on the bath wherein are entrapped and carried away both the foreign substance removed from the surface of the material and the gases created by electrolysis of the bath.

Other objects and features of the invention will clearly appear from the following detailed description of one embodiment thereof in a method of treating wire to remove foreign substances from the surface thereof, taken in connection with the accompanying drawing which represents, in part, diagrammatically, an apparatus by means of which the method of the invention may be practiced.

In the embodiment of the invention herein disclosed, it is desired to clean the surface of a metal wire or similar strand 19. This strand comes from any convenient supply means not shown, at the left of the apparatus shown in the drawing, and advances, at the right, from the apparatus to a take-up device or to some other kind of strand treating apparatus not shown. The nature of the supply from which the strand proceeds at the left and of the apparatus in which it is disposed of at the right forms no part of the present invention, and so is not necessary to be shown here, except for the fact that the metal strand is electrically grounded at some convenient point before it enters the apparatus disclosed or after it leaves the apparatus or both, as diagrammatically indicated at 18.

The apparatus disclosed is supported and assembled on a pair of parallel spaced horizontal

beams or girders 20, preferably of metal. These and all the apparatus supported thereby are electrically insulated from the ground, e. g. by being supported on insulating members 21 resting on pillars or pedestals 22.

An outer metal waste catching tank 23 is hung between the girders and has a waste outlet 25 connected by an insulating hose 25 to any suitable drain. Within this tank 23 are mounted a cleaning solution supply tank 30 and a washing tank 40, both also of metal. Overflow from either of the tanks 30 or 40 is caught in the tank 24 and disposed of via the outlet 23. A shallow horizontal cleaning tray or pan 31 is positioned in and extends substantially across the tank 30 near the upper edge thereof.

Insulating dams 32, 33, 34, 35, 41 and 42 are mounted at the top of the left edge of the tank 30, both ends of the tray 31, the right edge of the tank 30, and both edges of the tank 40, respectively, with their upper faces adjusted to lie in one and the same horizontal plane. The tank 30 is also provided with a drainage hole in the bottom emptying into the tank 24 and closed by a removable stopper 36.

A pumping device 37 of any suitable nature, such as a centrifugal pump, is arranged to be driven by a belt 38 from any convenient source of power not shown, and serves to lift fluid continually from the tank 30 and deliver it, as at 39, into the tray 31 whence the fluid overflows over the dams 33 and 34 into the tank 30 again thus keeping the tray 31 brimmingly full at all times.

Clean water from any suitable source is delivered through an insulating connection such as a rubber hose 42 into a pipe 43 lying in the tank 40 transversely across the bottom thereof. The pipe 43 is provided with a plurality of perforations 44 in its upper side and delivers water from these perforations upwardly into the tank 40. The water brims over the dams 41 and 42 and falls into the waste tank 24 to be disposed of via the outlet 23.

Guide rollers 50 and 51 are mounted at the incoming and outgoing ends of the apparatus in insulating blocks 52 and 53. A drip pan 54 may conveniently be provided under the roller 51 and emptying into the tank 24. The rollers 50 and 51 are preferably of relatively large diameter to avoid any marked bending of the strand in passing over the rollers. Also whether either roller is positioned above or below the strand depends on the direction in which the strand comes to or departs from the apparatus.

While only one strand 19 is definitely shown in the drawing, there may evidently be any practicable number of such strands running parallel to each other in the horizontal plane of the tops of the dams.

The supporting members 20 and all metal

parts secured to and directly supported thereby, such as the tank 30 and tray 31 particularly, are maintained at an alternating electric potential relatively to ground, and are insulated from ground by the members 21. A simple means to provide and maintain this potential is diagrammatically indicated in the drawing at 60 and is believed to need no particular description beyond the diagram, the generator 61 being designed to provide appropriate alternating current, and the transformer 62 being adjustably variable.

The tank 30 is filled, preferably to about the level of the bottom of the tray 31 as shown, with a suitable electrolytic cleaning solution containing both an electrolyte to carry current between the tray and the strand passing between the dams 33 and 34, and a foaming agent.

Preferably the electrolyte is relatively non-poisonous and alkaline, as solutions of such are, generally speaking, relatively less dangerous and difficult to handle than others. Suitable substances for this purpose are such as the alkali metal silicates, phosphates, carbonates and hydroxides, since the electrolysis of such solutions produces no poisonous or corrosive gases. Other electrolytes may, however, be used if suitable precautions are taken.

Generally, the electrolysis with alternating current of solutions of these electrolytes produces an evolution at the electrodes of an explosive and inflammable mixture of hydrogen and oxygen. If no particular precautions are taken this "detonating gas" may become entrapped or pocketed in dangerous quantities in the apparatus instead of being harmlessly diluted into the atmosphere.

It has been discovered that the addition of a suitable foaming agent to the solution, e. g. such substances as ordinary soap, rosin oil soap or any soluble soap, saponin, sulphonated or halogenated higher alcohols and the like, effects the result that the evolved gas is entrapped in segregated small portions in the bubbles of a mass of foam, in such fashion that even if the gas is accidentally ignited no severe explosion can take place and frequently even the propagation of the ignition from bubble to bubble is smothered out and halted. In some instances it may be well to add glycerine to aid in toughening the foam.

In one illustrative example the apparatus as disclosed was arranged to handle fifty several strands of 24 gage (A. W. G.) copper wire running parallel to each other over rollers 50 and 51 and over and in contact with the tops of the dams 32, 33, 34, 35, 41 and 42. The tank 30 was filled, about to the indicated level, with a solution made up in the following proportions:

Sodium orthosilicate (anhydrous) pounds	4.5
Household soap chips	0.5
Water	20

Since the pump 37 kept this solution brimming gently over the dams 33 and 34, the wires 19 were completely surrounded by the solution between the dams, the surface tension of the solution being sufficient to bank the solution up above the dams enough to bury the wires.

The generator 61 was proportioned and the transformer 62 proportioned and adjusted, so that the current density at the surface of the wires 19 between the dams 33 and 34 was roughly 1.25 amperes per sq. cm. running between lower and upper limits of about 1.0 and

1.5 amperes per sq. cm. In this particular instance the distance between the dams 33 and 34 was about 9.75 inches, and the wires 19 advanced at a rate of about 125 ft. per min.

Under these conditions the surface of the wire is satisfactorily cleaned and freed of undesired foreign matter. A toughly tenacious foam forms gradually on the surface of the liquor in the tray 31 and is swept along toward the right by the motion of the wires and partly falls over the dam 34 to rest on the surface of the solution in the tank 30. Chiefly, however, because of its lightness and coherent toughness, it is swept on and falls over the right hand edge of the tank 30. It is carried down into the bottom of the tank 30 partly by its own weight and partly by the sheet of water overbrimming the dam 41 toward the tank 30, which carries the foam down to where it is swept out via the outlet 23.

This foam not only entraps the gases evolved in the solution by the electrolytic cleansing action on the wires, but also entraps and carries away the dirt and solid debris cleaned from the wires, so that this last is thus automatically disposed of, whereas, in the absence of a foaming agent in the solution, such substances remain in and gradually foul the cleaning bath to unusability. By the present method, however, the bath remains clean substantially indefinitely.

The clean wash water overbrimming the dam 41 prevents the entry of any of the foam into the tank 40 and so helps to maintain this rinsing bath clean. In the bath 40, the residue of the cleaning solution is washed from the surface of the wire, and the latter emerges over the roller 51 clean and bright. The distance between the dams 35 and 41 may be practically whatever convenience may dictate, provided it be great enough to allow the foam to fall through. In the particular instance considered, this distance was about an inch.

While in the instant case the use of alternating current is preferred, it is clear that direct current may also be used if desired, particularly for example in the case of an article of material subject to severe cathodic but not anodic corrosion or vice versa.

The particular apparatus used to illustrate the practise of the method of the invention forms no part of the invention, having been in commercial use for the practise of other methods for several years.

The invention claimed resides wholly in the method disclosed herein in an illustrative example, but is not confined to the particular details of the illustration, which may be modified and departed from in various ways without departing from the spirit and scope of the invention as particularly pointed out in the appended claims.

What is claimed is:

1. A method of cleaning the surface of a metallic article which comprises steps of immersing the surface to be cleaned in a bath comprising a water solution of an alkaline electrolyte and a foaming agent, and passing an alternating electric current through the bath between the article as one electrode and another electrode, the detonating gas liberated at the electrodes coacting with the foaming agent in the bath to form a foam on the bath in which both the gas and foreign matter released from the surface by the electrolytic action are entrapped to be harmlessly carried away.

2. A method of cleaning the surface of a metallic article which comprises steps of immersing the surface to be cleaned in a bath comprising a water solution of an alkaline electrolyte and a foaming agent, passing an alternating electric current through the bath between the article as one electrode and another electrode, the detonating gas liberated at the electrodes coacting with the foaming agent in the bath to form a foam on the bath in which both the gas and foreign matter released from the surface by the electrolytic action are entrapped, and carrying away the foam to remove the entrapped gas and foreign matter.

3. A method of cleaning the surface of a metallic article which comprises steps of immersing the surface to be cleaned in a bath comprising a water solution of an alkaline electrolyte and a foaming agent, passing an alternating electric current through the bath between the article as one electrode and another electrode, the detonating gas liberated at the electrodes coacting with the foaming agent in the bath to form a foam on the bath in which both the gas and foreign matter released from the surface by the electrolytic action are entrapped, and creating relative motion of the article and bath to carry away the foam and the entrapped gas and foreign matter.

4. A method of cleaning the surface of a metallic article which comprises steps of immersing the surface to be cleaned in a bath comprising a water solution of an alkaline electrolyte and a foaming agent, passing an alternating electric current through the bath between the article as one electrode and another electrode, the detonating gas liberated at the electrodes coacting with the foaming agent in the bath to form a foam on the bath in which both the gas and foreign matter released from the surface by the electrolytic action are entrapped, and circulating the bath to create a current therein to carry away the foam and the entrapped gas and foreign matter.

5. A method of cleaning the surface of a metallic article which comprises steps of immersing the surface to be cleaned in a bath comprising a water solution of an alkaline electrolyte and a foaming agent, passing an alternating electric current through the bath between the article as one electrode and another electrode, the detonating gas liberated at the electrodes coacting with the foaming agent in the bath to form a foam on the bath in which both the gas and foreign matter released from the surface by the electrolytic action are entrapped, and moving the article through the bath to sweep the foam and the entrapped gas and foreign matter therefrom.

6. A method of cleaning the surface of a metallic article which comprises steps of immersing the surface to be cleaned in a bath comprising a water solution of an alkaline electrolyte and a foaming agent, passing an alternating electric current through the bath between the article as one electrode and another electrode, the detonating gas liberated at the electrodes coacting with the foaming agent in the bath to form a foam on the bath in which both the gas and foreign matter released from the surface by the electrolytic action are entrapped, circulating the bath to create a current therein to carry away the foam and the entrapped gas and foreign matter, and moving the article through the bath to sweep the foam and the entrapped gas and foreign matter therefrom.

7. A method of cleaning the surface of a me-

talic article which comprises steps of immersing the surface to be cleaned in a bath comprising a water solution of an alkaline electrolyte and a foaming agent, passing an alternating electric current through the bath between the article as one electrode and another electrode, the detonating gas liberated at the electrodes coacting with the foaming agent in the bath to form a foam on the bath in which both the gas and foreign matter released from the surface by the electrolytic action are entrapped, and removing the foam with its entrapped gas and foreign matter from the article.

8. A method of cleaning the surface of a metallic article which comprises steps of immersing the surface to be cleaned in a bath comprising a water solution of an alkaline electrolyte and a sufficient quantity of a foaming agent to produce in coaction with gas evolved into the bath a layer of foam on the surface of the bath, and passing an alternating electric current through the bath between the article as one electrode and another electrode, the detonating gas liberated at the electrodes coacting with the foaming agent in the bath to form a foam on the bath in which both the gas and foreign matter released from the surface by the electrolytic action are entrapped to be harmlessly carried away.

9. A method of cleaning the surface of a metallic article which comprises steps of immersing the surface to be cleaned in a bath comprising a water solution of an alkaline electrolyte and a sufficient quantity of a soluble soap to produce in coaction with gas evolved into the bath a layer of foam on the surface of the bath, and passing an alternating electric current through the bath between the article as one electrode and another electrode, the detonating gas liberated at the electrodes coacting with the foaming agent in the bath to form a foam on the bath in which both the gas and foreign matter released from the surface by the electrolytic action are entrapped to be harmlessly carried away.

10. A method of cleaning the surface of a metallic article which comprises steps of immersing the surface to be cleaned in a bath comprising a water solution of an alkaline electrolyte and a sufficient quantity of saponin to produce in coaction with gas evolved into the bath a layer of foam on the surface of the bath, and passing an alternating electric current through the bath between the article as one electrode and another electrode, the detonating gas liberated at the electrodes coacting with the foaming agent in the bath to form a foam on the bath in which both the gas and foreign matter released from the surface by the electrolytic action are entrapped to be harmlessly carried away.

11. A method of cleaning the surface of a metallic article which comprises steps of immersing the surface to be cleaned in a bath comprising a water solution of an alkaline electrolyte and a sufficient quantity of a sulphonated alcohol to produce in coaction with gas evolved into the bath a layer of foam on the surface of the bath, and passing an alternating electric current through the bath between the article as one electrode and another electrode, the detonating gas liberated at the electrodes coacting with the foaming agent in the bath to form a foam on the bath in which both the gas and foreign matter released from the surface by the electrolytic action are entrapped to be harmlessly carried away.

CHRISTOPHER J. KROGEL.