March 6, 1956 A. N. GRAY 2,737,488

ELECTROPLATING APPARATUS

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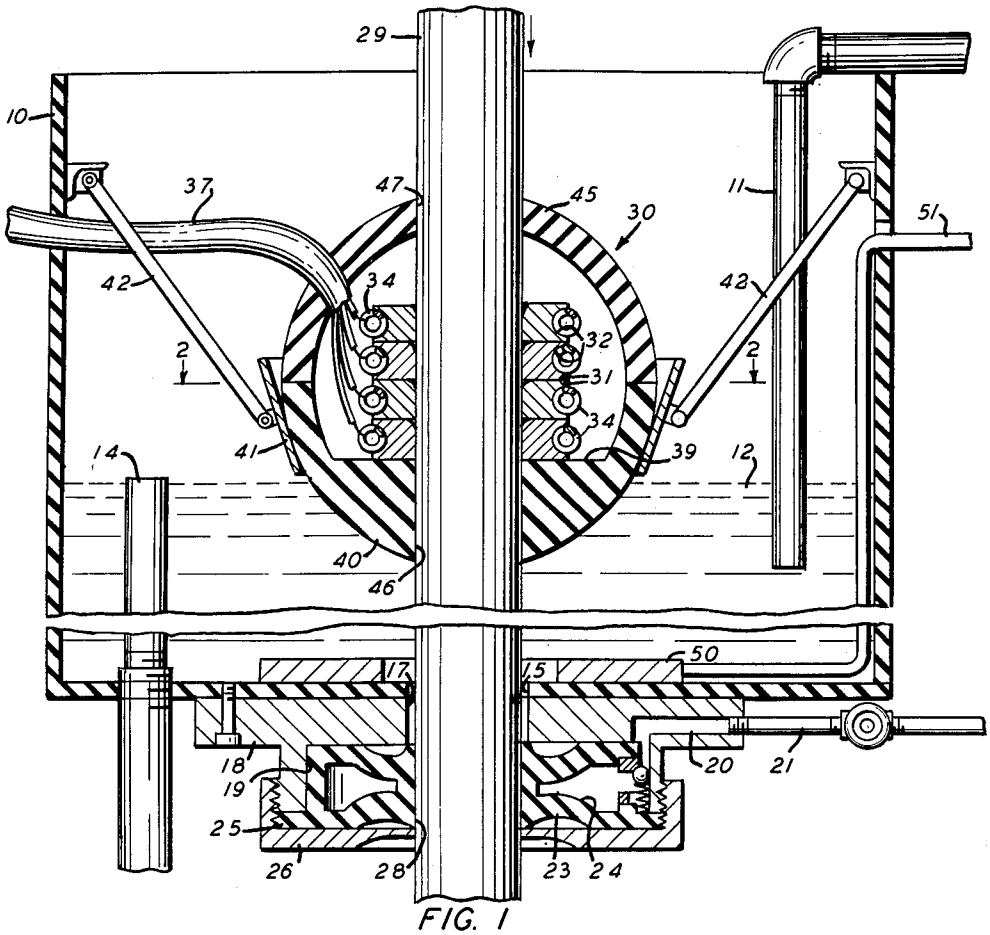


FIG. 1

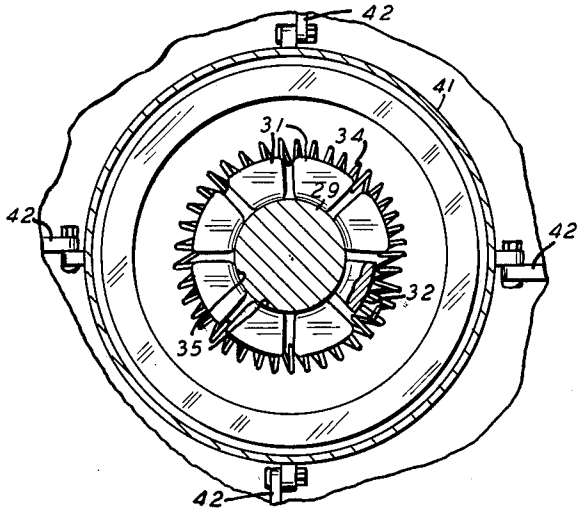


FIG. 2

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ELECTROPLATING APPARATUS

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This invention relates to electroplating apparatus, and more particularly to apparatus for electroplating articles of indefinite lengths.

It is sometimes desirable to electroplate a layer of metal upon an article of indefinite length which has a surface of rather low conductivity. For example, it may be desired to electroplate a metallic coating on a length of wire which has been drawn from a wire rod by a wire drawing process utilizing lead as a lubricant for the wire drawing dies. In such a case, the wire to be plated may have an irregular, thin layer of lead thereon which varies in thickness and which may be discontinuous. In other words, the lead coating left on the wire after the wire drawing process may be spotty and variable. Such a coating may make it difficult to obtain a good deposit by the use of apparatus such as have been used in the past to apply electroplated coatings to wires.

In some instances, it is advantageous to apply a metallic film or coating on an electric cable having an insulating covering on the exterior thereof. Thus, in certain types of communication cables, it is the practice of enclose the elements of the cable in a sheath of polyethylene, or other suitable plastic. When it is desired to electroplate a metallic coating on such a plastic sheath, it is necessary to apply to the sheath a preliminary conducting coating of graphite, or the like, and apparatus of known designs are not entirely suitable for electroplating such cables because of the difficulties encountered in making good electrical contact with the preliminary conducting coating.

An object of the invention is to provide new and improved electroplating apparatus.

Another object of the invention is to provide new and improved apparatus for electroplating articles of indefinite length.

One type of electroplating apparatus illustrating certain features of the invention may comprise a tank for holding an electrolyte, sealing means for permitting an article of indefinite length to be passed vertically through the tank without loss of the electrolyte, a resilient contactor for engaging such an article advancing through the tank, and a casing enclosing the contactor and the adjacent portions of the article for protecting the same from exposure to the electrolyte.

The above-mentioned and other objects and features of the invention will be apparent from the following detailed description of an apparatus embodying the invention, when taken in conjunction with the accompanying drawings, in which:

Fig. 1 is a fragmentary, vertical section of the apparatus, and

Fig. 2 is a fragmentary, horizontal section taken along line 2—2 of Fig. 1.

Referring now to Fig. 1 of the drawings, there is shown an elongated, vertically disposed tank 10 made of a suitable insulating material, such as hard rubber, or the like, into which extends an inlet pipe 11 for introducing an electroplating solution 12 into the tank. An overflow

pipe 14 projects upwardly from the bottom of the tank 10 so as to maintain the electroplating solution 12 at the desired level in the tank.

The bottom of the tank 10 is provided with an aperture 15 which matches an aperture 17 formed in a block 18, fastened to the bottom of the tank. The block 18 has a chamber 19 formed therein, which is connected by means of a channel 20 with a pipe 21 leading to a source of high pressure air. Positioned within the chamber 19 is a flexible sealing member 23 having an annular chamber 24 which communicates with the channel 20. The sealing member 23 has an annular flange 25 formed on the bottom thereof, which is engaged by a centrally apertured cap 26 threaded upon the wall of the chamber 19 to secure the flexible member in place.

The flexible sealing member 23 has a central aperture 28 formed therein through which may advance an article 29 of indefinite length, upon which an electroplated coating is to be formed. When air under pressure is introduced into the chamber 24, the air will tend to expand the resilient member 23. The expansion of the member 23 causes it to grip the peripheral surface of the article 29 with sufficient force to prevent leakage of the electroplating solution 12 from the tank 10, despite the fact that the article is being advanced continuously through the electrolyte and out of the bottom of the tank through the apertures 15, 17 and 28.

Near the top of the tank 10 there is provided a contactor unit, designated generally by the numeral 30. This unit includes a plurality of sector-like contactors 31—31 having grooves 32—32 formed in the peripheral surfaces thereof for the reception of endless springs 34—34. Each of the contactors 31—31 has an arcuate inner surface 35 designed to engage the outer surface of the article 29, and the springs 34—34 urge the contactors inwardly into tight contact with the article. The contactors are of such size that, when they are in engagement with the article 29, the sides thereof do not touch each other so that there is free play of the contactors, and each of them will engage the article firmly. This construction also permits wear on the contactors to proceed for a considerable period of time before the contactors have to be replaced.

The contactors 31—31 may be made of any suitable conducting material, such as graphite or compressed comminuted copper, or the like. A lead wire 37, connected to a source of negative D. C. potential, is attached to each of the springs 34—34 so as to impress a negative potential upon the contactors 31—31, and through them upon the article 29 to make the article the cathode.

The contactors 31—31 rest upon a flat bottom 39 of a molded substantially hemispherical member 40, which engages a tapered ring 41, supported by a plurality of rods 42—42. An upper molded, hemispherical member 45, through the wall of which the lead wire 37 extends, is placed over the contactors and is sealed to the lower casing member 40 so as to form a spherical, liquid-tight casing enclosing the contactors 31—31, the springs 34—34, and the end of the lead wire 37 connected to the springs.

The lower member 40 has a circular aperture 46 formed therein, and the upper member 45 has a similar aperture 47 formed therein in alignment with the aperture 46 so as to permit the article 29 to pass through the walls thereof and to be engaged by the contactors 31—31. The members 40 and 45 are made of a suitable resilient material, such as vulcanized rubber, or the like, which will withstand the corrosive action of the electroplating solution 12. The apertures 46 and 47, formed in the members 40 and 45, are slightly smaller than the diameter of the article 29 so that as the article 29 is advanced therethrough the apertures 46 and 47 expand slightly. Due to the resiliency of the material of which the mem-

bers 40 and 45 are made, the sides of the apertures 46 and 47 form a substantially liquid-tight seal with the periphery of the article 29, and prevent the electroplating solution 12 from reaching the contactors 31—31, the springs 34—34, the lead wire 37, and the portions of the article 29 adjacent to the contactors.

An electrode 50 is positioned upon the bottom of the tank 10. This electrode may assume various forms, but in the embodiment shown it is an annular disc which surrounds the path of the article 29. The electrode 50 may be made of a material which is soluble in the electrolyte and which forms a metallic ion in the electroplating bath, which is to be plated upon the article 29. Alternatively, the electrode 50 may be made of an insoluble material and act as an insoluble anode. In the latter case, the depletion of the electroplating bath caused by the electroplating process is prevented by continuously circulating electrolyte through the tank 10 and by replenishing the metal ion in the plating solution exteriorly of the tank 10 in a known manner. A positive potential is applied to the electrode 50 by means of an insulated bar 51, which is connected to a suitable source of D. C. potential. Whatever form the anode 50 assumes, it obviously must remain out of contact with the article 29 upon which a metallic coating is plated in its passage through the electroplating solution.

Apparatus of the type described hereinabove may be used to electroplate a coating of a single metal, such as copper, tin or lead, upon a conducting core, which may be in the form of a wire of indefinite length. Such a wire would be advanced through the aforementioned apparatus at a constant rate of speed by any suitable means of known design, such as a power-driven capstan. Furthermore, this apparatus may be used to apply a coating of a metal, such as copper, upon a cable sheathed with an insulating material, such as polyethylene, to which a thin layer of a conducting material, such as graphite, has been applied to form a conducting base for the electrodeposited coating. If desired, the apparatus may be used to apply a brass coating directly to a lead sheath of a cable to which sheath a coating of a vulcanizable compound of rubber, or the like, is to be applied and vulcanized thereon. Despite the softness of the lead sheath, good contact may be made therewith by means of this apparatus without damaging the sheath. Obviously, the apparatus may be utilized to apply coatings of various metals upon conducting cores of any suitable type.

The ring 41, which supports the member 40, is positioned near the upper surface of the electroplating solution 12 so as to permit the lower portion of the member 40 to dip beneath that surface. However, the member 40 is restrained by the ring 41 from passing through the ring, and the ring prevents the casing formed by the hemispherical members 40 and 45 from being totally immersed in the electroplating solution.

The advantage of this particular arrangement is that the contactors 31—31 engage the article 29 at a point only slightly removed from the electroplating solution, but at the same time the contactors and related elements are protected from contamination and erosion, which would result if the electrolyte were allowed to come into contact therewith. By applying an electrical potential to the article at a point very near to the electrolyte in which it is to be electroplated, there is a minimum lowering of potential caused by the IR drop in the conducting portion of the article, and, as a result, the plating current density is proportionately high.

The contactors 31—31 engage the article with a substantial pressure and effect a good electrical contact therewith, even though the surface of the article may not be too highly conductive, or is spotty and irregular. Because the contactors have free play, they adapt themselves readily to irregularities of the surface of the article to be plated, yet because of the inward pressure exerted by the springs 34—34, the contactors remain in intimate contact with the article.

The contacting unit 30 is compact and relatively simple in construction, yet is rugged and capable of protecting the elements thereof from contamination by contact with the electroplating solution. The tank 10 is made sufficiently deep and the speed of the article passing therethrough is adjusted to permit a metallic coating of a desired thickness to be plated on the article before it emerges from the bottom of the tank.

While one specific embodiment of the invention has been shown and described in detail, it is obvious that various modifications may be made therein without departing from the spirit and scope of invention.

What is claimed is:

1. Electroplating apparatus, which comprises an electrolytic cell having an opening in the bottom thereof, means for maintaining an electroplating solution at a predetermined level above the bottom of the cell, a seal mounted at the opening for preventing leakage of the solution from the bottom of the cell while permitting a wire being electroplated therein to advance vertically therethrough, an anodically charged electrode immersed in the solution in the cell, a plurality of arcuate conductors closely spaced in end-to-end and side-to-side relationship to form a series of rings encircling the wire, resilient means for urging the conductors in each of the rings radially inward into contact with the wire, means for impressing a negative potential upon each of the rings to make the wire cathodic in the cell, a hollow rubber sphere enclosing the rings and the adjacent portion of the wire, said sphere being provided with a pair of vertically aligned apertures on opposite sides thereof and of such size as to permit the wire to advance therethrough but to form a substantially liquid-tight seal therewith, and means for supporting the sphere closely adjacent to the level of the surface of the electroplating solution.

2. Electroplating apparatus, which comprises an electrolytic cell having an opening in the bottom thereof, means for maintaining an electroplating solution at a predetermined level above the bottom of the cell, a seal mounted at the opening for preventing leakage of the solution from the bottom of the cell while permitting a wire being electroplated therein to advance vertically therethrough, an anodically charged electrode immersed in the solution in the cell, a plurality of arcuate conductors closely spaced in end-to-end and side-to-side relationship to form a series of rings encircling the wire, a plurality of endless springs one of which encircles each of the rings and urges the contactors in each of the rings radially inward into contact with the wire, means for impressing a negative potential upon each of the springs to make the wire cathodic in the cell, a hollow rubber sphere enclosing the rings and the adjacent portion of the wire, said sphere being provided with a pair of vertically aligned apertures on opposite sides thereof and of such size as to permit the wire to advance therethrough but to form a substantially liquid-tight seal therewith, and means for supporting the sphere closely adjacent to the level on the surface of the electroplating solution.

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