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ELECTROPLATING APPARATUS

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2 Sheets-Sheet 1

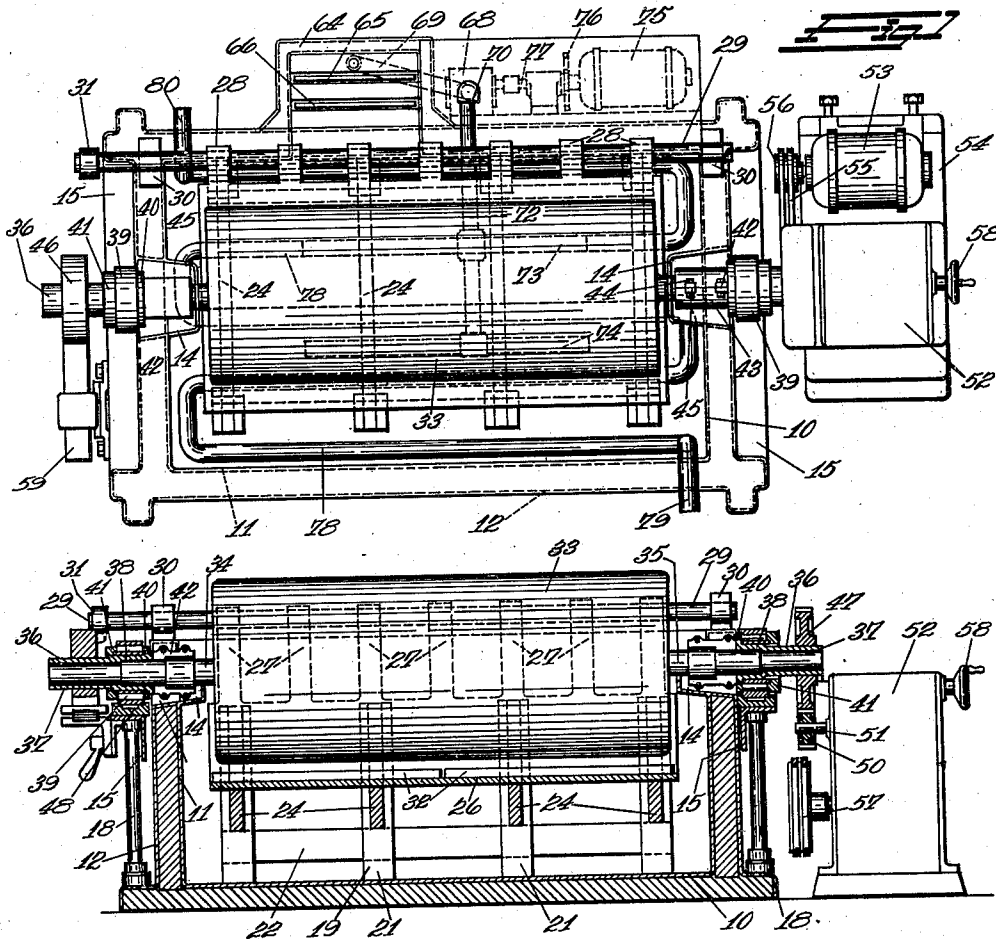


Fig. 1

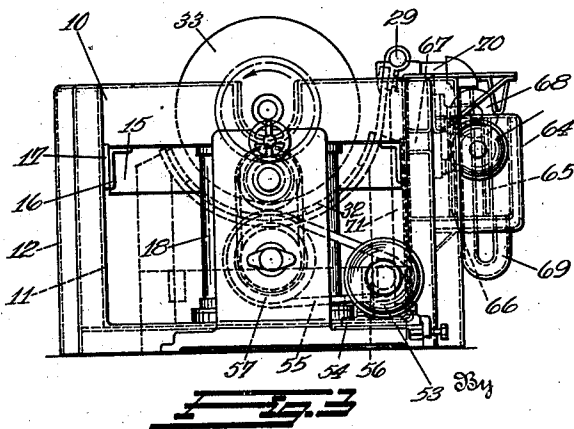
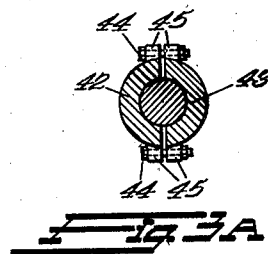


Fig. 2



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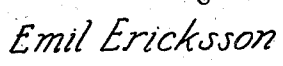
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UNITED STATES PATENT OFFICE

2,055,070

ELECTROPLATING APPARATUS

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10 Claims. (Cl. 204—5)

This invention relates to an electroplating apparatus designed to expeditiously deposit a dense layer of metal of the same thickness upon a cylinder while it is being rotated through the electrolyte. More particularly, the invention relates to an apparatus for electroplating a thin removable shell upon a cylinder intended for use in rotogravure and similar printing presses, so that the shell will have the characteristics of uniform density and thickness, enabling it to be etched for use in intaglio printing or the like with a minimum amount of burnishing or polishing prior to the etching.

In rotogravure or similar printing, it is now customary to provide a printing cylinder of a fixed diameter having a surface polished to a mirror-like finish, and to form the printing surface upon said cylinder by electroplating thereon a thin layer of metal, such as copper or the like, of about .006 inch thickness, the layer of copper being deposited upon the cylinder in such manner that it can subsequently be stripped therefrom by slitting the deposit longitudinally of the cylinder. In view of the fact that the printing surface is obtained by etching minute depressions in the outer surface of the deposit, it is essential that the deposited metal be free of imperfection and have a density that is uniform throughout the layer and that it be of exactly the required thickness at every point. The electro-deposition of layers having the characteristics just stated has been found to require an apparatus that, in its operation, will insure the continuous circulation of fresh electrolyte through the gap, separating the electric poles, to the end that precisely the same depositing action takes place at every point between said poles.

It has also been found essential, in order to secure the uniform deposit required for the special use of the electro-deposited layer to which attention has above been directed, to maintain the poles between which the current flows substantially parallel to each other where immersed in the electrolyte.

It has been further found that in order to secure the formation of the desired coating of uniform thickness and density, it is essential that the cylinder, which constitutes one of the electric poles, be rotated through the electrolyte at a relatively high surface speed such as 6 to 8 hundred feet per minute, that electrolyte of substantially the same character be continuously maintained in the gap between the electric poles, and that a uniform relatively high current density be maintained across said gap when the latter

approximates $1\frac{1}{2}$ inches, the preferred distance between the poles.

The primary purpose of the present invention is to provide an apparatus capable of efficiently electroplating printing cylinders to provide them with the layer of metal having the characteristics above described after the manner found to be essential in actual practice.

A further object of the invention is to provide an electroplating apparatus, in which use can be made of bars of the metal to be deposited of uniform width and thickness, and in which the stationary pole is made approximately parallel to the surface of the cylinder by supporting the bars in cradle-like structure having a supporting surface that generally parallels the surface of the cylinder upon which the deposit is to be made.

A still further object of the invention is to provide an electroplating apparatus designed so that bars of the metal to be deposited of uniform width and thickness may be completely consumed in the apparatus without sacrifice of the essential characteristic that the stationary pole generally parallel the surface of the cylinder, where said cylinder is immersed in the electrolyte.

Still another object of the invention is to provide a stationary pole for an electroplating apparatus consisting of a trough-like supporting cradle constructed of material that is not affected by the electroplating action and including bars of uniform width and thickness arranged in the trough of the cradle side by side and/or end to end so as to substantially completely cover the trough and approximately parallel the surface of the cylinder which is used to constitute the other pole of the apparatus.

Another object of the invention is to provide an electroplating apparatus, designed for the purpose of depositing a uniform dense layer of metal upon a cylinder, in which the cylinder is arranged and disposed so that its rotation causes a continuous circulation of fresh electrolyte between it and its cooperating stationary pole and in which use is made of the circulation of the electrolyte, thus initiated, to purify the solution.

A further object of the invention is to provide an electroplating apparatus including a filter associated with the receptacle in which the electrolyte is disposed so that in the normal use of the apparatus the electrolyte will flow continuously through the filter and be returned to the receptacle so as to agitate the electrolyte therein and maintain a uniformity in character of said electrolyte.

Still another object of the invention is to pro-

vide an electroplating apparatus including a filter and a positive pumping means, independent of the action of the electroplating apparatus, to insure a circulation of the electrolyte from the filter to the receptacle containing the electrolyte forming a part of the apparatus and to, in said circulation, insure an agitation of the electrolyte in the receptacle.

Still another object of the invention is to provide a cylinder electroplating apparatus including novel means for readily providing the cylinder shaft sections, provided for application of the cylinder to a printing press, with the means necessary to support the cylinder in the electroplating apparatus so that the minimum of friction occurs between its support during its rotation in the electrolyte and with the mechanism necessary to accomplish the rotation of the cylinder and the completion of the electric circuit of which the cylinder constitutes a part during the electroplating operation.

Still another object of the invention is to provide an electroplating apparatus designed to form a deposit of metal upon a cylinder in which open journal boxes are used to support the cylinder which is provided with the desirable anti-friction bearings fitting within said boxes by mounting the same upon sleeves that may be detachably clamped upon the shaft sections of the cylinder.

Still further objects of the invention will appear as a description thereof proceeds with reference to the accompanying drawings in which:

Figure 1 is a plan view of the preferred form of electroplating apparatus constituting the present invention.

Figure 2 is a vertical sectional view of the apparatus appearing in Figure 1.

Figure 3 is an end view of the apparatus as seen from the right of Figure 2.

Figure 3a is a detail view on an enlarged scale showing the split sleeve for clamping the cylinder shaft in position.

Figure 4 is an end view of the receptacle or tank on a slightly enlarged scale.

Figure 5 is a view of a preferred form of current collector brush arrangement, for the cylinder constituting one of the electric poles of the apparatus.

Figure 6 is a diagrammatic view showing the cradle arrangement for supporting the bars constituting the stationary pole of the apparatus and the relation of the cylinder and electrolyte level to said bars.

Figure 7 is a side view of the cradle for supporting the separate bars constituting the stationary pole of the apparatus.

Like reference characters indicate like parts throughout the several figures.

The electroplating apparatus of the present invention comprises a tank or receptacle 10, which may be constructed of wood in convenient form, and which may preferably be lined internally with lead or similar metal, as indicated by 11. The lining 11 may be carried over the edges of the tank or receptacle and may if desired cover the exterior of the tank or receptacle as indicated at 12, so that the wood, from which the tank or receptacle is preferably constructed, is completely protected from contact with the electrolyte, even if any of the electrolyte is splashed over the edges of the tank or receptacle. The lining is formed to cover notches 13 formed in the ends of the tank for the passage of the shaft sections of the cylinder constituting one of the

electric poles, and is turned inwardly adjacent said notches to form a housing 14 for detachable sleeves that are applied to shaft sections of the cylinder prior to the insertion of the cylinder in the electrolyte. The tank may be constructed in any convenient form though preferably it is constructed in rectangular form.

At each end of the tank or receptacle on the exterior thereof angle irons or similar supporting members 15 extend transversely between vertical frame members of the tank, being secured to said frame members in any convenient manner, as by brackets 16 and blocks 17. Extending between each of said members 15 and the base of the apparatus are a plurality of struts 18, the ends of which are threaded into suitable connectors serving to rigidly unite said ends to the bars 15 and the base of the apparatus so that any weight resting upon the bars 15 is transmitted through said struts to said base. The cylinder to be electroplated in the apparatus, constituting the present invention, is supported upon the bars 15, in a manner hereinafter described.

Supported on the floor of the tank or receptacle just described is a cradle 19, illustrated best in Figures 6 and 7 of the drawings. Said cradle consists of a multiplicity of parallel vertically extending supporting bars 20 and 21, that are connected together in spaced relation by horizontally extending members 22 and 23, said members preferably being notched at intervals to receive the vertical members 20 and 21 in lateral immovable relation therein. Extending between the oppositely disposed vertically extending members 20 and 21 respectively, are a plurality of frame members 24 which are suitably secured to said members and rest upon the horizontal members 22 and 23 of the cradle. The supporting members 24 and the upper edges of the vertically extending members 20 and 21 are formed to provide a curved supporting surface 25 which is constructed of a contour that approximately parallels the surface of the cylinder to be electroplated in the apparatus, when said cylinder is in place therein. That is, the supporting surface 25 is preferably of arcuate form drawn from the axis of rotation of the cylinder. Deviations from a true arc drawn from said center are contemplated as coming within the scope of the present invention so long as the supporting surface 25 approximately parallels the surface of the cylinder when the cylinder is in place in the apparatus.

The frame of the cradle so far described is preferably constructed of wood and the wood is treated with a bituminous composition, rubberoid or similar paint protecting it from the action of the electrolyte within the receptacle. Supported on the cradle frame just described is a sheet of metal 26, preferably lead, which follows the contour of the supporting surface 25. Preferably the sheet of lead is cut so as to provide a multiplicity of extensions 27, each of which is connected to a split sleeve 28 that is clamped around a bar 29 preferably constructed of copper. The bar 29 is supported in brackets 30 secured to the top of the tank, and adjacent one or both ends thereof are provided with connectors 31 that are united in any suitable manner to a conductor forming a part of the system for supplying electric current to the apparatus. When the apparatus is used for plating cylinders the positive conductor is connected to the connector 31, the bars supported in the cradle presently to be referred to in this instance constituting the anode of the electro-

plating apparatus. If the apparatus is used for deplating cylinders as it is capable of being used as hereinafter pointed out, the current may be reversed in any approved manner and the bars supporting the cradle in this instance constitute the cathode of the apparatus.

The cradle just described is used to support a multiplicity of bars 32 of copper, or the metal that is to be deposited upon the cylinder, in side by side and/or end to end arrangement upon the cradle. The bars 32 may be arranged to completely cover the cradle. As illustrated, each of the bars 32 is of the same width and thickness and when disposed in the cradle, as illustrated, produces a plate-like electric pole presenting the desired curvature approximately or exactly paralleling the surfaces of the cylinder to be electroplated in the apparatus. This arrangement provides a simple mode of using bars of the same width and thickness to form an electric pole having the curved contour essential to the efficient production of the electro-deposited layer having the characteristics above pointed out.

Said bars can be substantially completely used in the electroplating operation without resulting in disintegration of the curved pole, such as would result if a pole consisting of a plate-like structure especially constructed to provide the desired parallelism between the cylinder surface and the surface of the pole were utilized. Furthermore by utilizing a supporting cradle such as just described, and bars of metal of uniform width and thickness to line the supporting structure of the cradle, it is possible to completely use the metal in the electroplating operation, because when the bars have been used to the extent of about one-half of their weight or less, the partially used bars are removed and the cradle is relined with new bars and the partially used bars may be arranged in juxtaposition upon the new bars and the apparatus continued in use. This is an effective way to use the described arrangement and result in a complete use of the partially disintegrated bars in the electro-plating action and the subsequent use of the new bars upon which the partially disintegrated bars are supported. The described arrangement accordingly provides a simple and inexpensive apparatus enabling uncurved bars of uniform width and thickness to be used to form a curved electric pole and at the same time enables the metal from which the curved pole is thus formed to be completely consumed in the electro-plating operation, though an electric pole is assured that has a form found to be necessary in order to secure the character of deposit that is required in the formation of shells intended to be subsequently etched and used in printing operations.

The cylinder 33 to be electroplated in the apparatus of the present invention constitutes the base of a printing cylinder having shaft sections 34 and 35 extending from opposite ends thereof which shaft sections are secured in suitable bearings in the printing press when the cylinder has been provided with a layer of metal in the present apparatus and said layer has been etched to provide the printing surface.

The surface of the cylinder, prior to its insertion in the apparatus of the present invention, is provided with a metal like finish and contains a surface layer of metal, such as nickel that will not unite to the metal, subsequently deposited thereon, so intimately as to prevent subsequent stripping of the electro-deposited layer after the printing cylinder has served its purposes, so that

a new layer of metal may be electro-deposited thereon and the desired printing surface etched in the new layer of deposited metal.

While it is preferred to strip the copper or like layer from the printing cylinder after the required number of impressions has been made, said deposited layer may be removed by again positioning the plated cylinder in the apparatus of the present invention, reversing the current, and thus deplating the cylinder in the same apparatus. When it is desired to remove the printing surface in this manner, it is necessary that the base be provided with a surface that is unaffected by the deplating action so that the cylinder can be again replated and reused without the necessity of grinding or polishing the surface thereof in order to secure the absolutely smooth and the true cylindrical surface that is essential in a printing cylinder.

Rotation of the cylinder in the electrolyte may begin immediately upon immersion of a part of the cylinder therein. It has been found desirable to support the cylinder in open bearing boxes and to assemble, the bearings, the gearing for rotating the cylinder, and the current collector upon the cylinder prior to the immersion of a part thereof in the electrolyte. This is accomplished in the present invention by providing sleeves that are clamped upon the shaft sections 34 and 35 before the bearings are disposed in said open boxes and the cylinder thus immersed in the solution, said sleeves carrying the gear for rotating the cylinder and the current collector prior to the application of the cylinder to the tank or receptacle. The sleeve 36 consists of a tubular portion 37 formed integrally with an enlarged tubular portion 38 upon which roller bearings 39 are mounted between the collars 40 and 41 threaded, or otherwise, suitably secured upon the section 38 of said sleeve. Each sleeve is further provided with a portion 42 that is split longitudinally to provide a removable cap section 43 between which cap and the portion 42 the shaft sections are rigidly clamped by means of bolts 44 passing through aligned ears 45 in the portion 42 and the cap section 43 separated therefrom in a manner that will be obvious from an inspection of Figure 3a of the drawings.

Secured to the sleeve 36 that is clamped upon the shaft section 34 is a current collector 46, while secured to the sleeve 36 that is clamped upon the shaft section 35 is a gear 47. It will thus be seen that when the sleeves 36 are attached to the shaft sections of the cylinder, that is to be electroplated by clamping the caps 43 into embracing engagement with said shaft sections, the bearings 39, the current collector 46, and the gear 47, that is used to rotate the cylinder in the electrolyte, are supplied to the cylinder as units thus providing the cylinder with means for sustaining it with a minimum of friction during rotation thereof, with means for completing the electric circuit through the cylinder, and with means for rotating the cylinder, all of which may be applied to the cylinder with great expedition. It will be seen that when it is desired to electroplate a cylinder the sleeves 36 are simply applied thereto in the simple manner stated and when the electroplating operation has been completed and the cylinder removed from the tank the sleeves can readily be removed and applied to another cylinder with a minimum loss of time.

Upon application of the cylinder to the tank or receptacle, the bearings 39 are dropped in

open bearing boxes 48 rigidly attached to the angle bars 15 before described, which are suitably secured to said angle bars as by means of bolts 49, (Figure 4). The gear 47 is brought into engagement with a pinion 50 secured to a shaft 51 forming a part of a speed change device arranged in casing 52. The shaft 51 is driven at varying rates of speed from a motor 53 mounted upon a suitable base 54 disposed adjacent the tank or receptacle, said motor being operatively connected to the speed change gearing within the casing 52 by means of a belt 55 and pulleys 56 and 57 on the drive shaft of the motor and on the driven shaft of the speed change device respectively. A suitable handle 58 may be manipulated to vary the speed of the shaft 51 so that the angular velocity of the cylinder through the electrolyte may be varied to attain a peripheral speed of 600 to 800 feet per minute irrespective of the diameter of the cylinder upon which the coating is to be electro-deposited. The speed changing device within the casing 52 may be of any approved form.

When the cylinder is positioned with the bearings 39 in the open boxes 48 the current collector 46 (Figure 5) contacts with the ends of a brush 59, consisting of a multiplicity of laminations of phosphor bronze or the like having their respective ends formed to contact with a substantial part of the cylindrical periphery of said current collector. Said laminations are clamped between a grooved supporting member 60 and an overlying grooved clamping plate 61 that may be drawn toward the support 60 by means of a bolt 62 so as to firmly hold the laminations immovable with respect to each other and with respect to the current collector 46. The support 60 is secured to the angle bar 15 in any approved manner, so as to be insulated therefrom, and said support is connected in any approved manner, as by clamp 63, to a conductor leading to the source of energy supplying current to the electroplating apparatus in any manner well understood in the art.

In order to maintain the electrolyte free of impurities, and to ensure the uniform character thereof throughout the tank to the end that the uniformity of the plating be ensured, and imperfections avoided in the plated coating, the apparatus of the present invention includes means to filter the solution continuously during the operation thereof and to ensure agitation of the electrolyte so that it is of substantially the same character at every point in the tank or receptacle, and particularly where the electrolyte is drawn in the gap between poles in a manner hereinafter described. The preferred filtering arrangement includes a supplementary tank or receptacle 64 which may be constructed of wood and lined, internally and externally with metal such as lead. Filters 65 and 66 extend vertically from the bottom of the tank to the top thereof, dividing said tank into a plurality of compartments. The filters preferably consist of an open frame of Monel metal or the like, supporting pure wool felt. The receptacle 64 is in communication with the interior of the tank 10 by means of an elongated passage 67 (Figure 3) located so that when the electrolyte is at the normal level within the tank 10, the electrolyte will flow into the auxiliary tank 64. The electrolyte flows first into the compartment to the left of the filter 66 (Figure 3) and passes through said filter into the compartment between the filters 65 and 66, and finally passes through the

filter 65 into the compartment between the filter 65 and the wall of the tank 64 most remote from the tank 10, said electrolyte being freed of suspended impurities during the passage through said filters.

In order to ensure continuous circulation of the electrolyte from the tank or receptacle 10 through the various compartments of the auxiliary tank 64, a pump 68 is provided which pump is put in communication with the bottom of the compartment formed between the filter 65 and the rear wall of the auxiliary tank 64 by means of a conduit 69 (Figure 3). The pump 68 returns the electrolyte to the tank 10 through conduit 70 connected thereto and extending along the wall of the tank 10 adjacent the auxiliary or supplemental receptacle 64, as indicated at 71 to a point beneath the stationary pole of the apparatus, where the conduit 71 is in communication with a conduit 72 extending across the tank and communicating with a pair of discharge conduits 73 and 74 (Figure 1) having open ends discharging the electrolyte returned to the tank by the pump 68, adjacent the bottom of the receptacle 10 at a plurality of points. The pump 68 is driven by a motor 75 having a pinion in mesh with a gear 76 affixed to a shaft 77 connected to the rotor of the pump which may assume any desired form known in the art.

It has been found to be desirable to maintain the temperature of the electrolyte at the same point throughout the year so that the action of the apparatus is substantially the same at all times. This result is attained by passing a suitable heating or cooling medium through a coil 78 (Figure 1) disposed within the tank 10, adjacent the bottom thereof. Said coil is provided with a cooling or heating medium through an inlet pipe 79, and said coil discharges the cooling or heating means through an outlet pipe 80, such fluid being pumped through the coil in any approved manner. It has been found to be desirable to maintain the temperature of the electrolyte at 100° F., which temperature will require the application of the heating medium to the coil 78 during the winter months and the application of the cooling medium during the summer months of the year.

Referring to Figure 6 of the drawings in the use of the apparatus the electrolyte is maintained at the level indicated by the line so designated in this figure, and the cylinder is rotated in the direction indicated by the arrow appearing on said view. It will be observed that the edge of the stationary pole, which is substantially completely immersed in the electrolyte as shown, at the side of the cylinder that moves downward through the electrolyte upon rotation thereof, is below the normal level of the electrolyte, and that at the side of the cylinder which moves upward, when it is rotated in the direction indicated by the arrow, the edge of the stationary pole is slightly above the electrolyte level. The effect of this arrangement is that the rotation of the cylinder causes a continuous circulation of electrolyte through the gap between the cylinder and the bars 32 supported in the cradle, because the action of the cylinder, which is rotated relatively rapidly as above stated, sets up a pumping action drawing fresh electrolyte continuously over the right hand edge of the stationary pole, viewing Figure 6, and discharges electrolyte that is passed through the gap continuously over the left hand edge of said pole. The result of this action is that

the nature of the electrolyte is maintained constant at all times during the electroplating action, resulting in an even deposition upon the cylinder. The uniformity with which the stationary pole is spaced from the cylinder is a further important feature contributing to the attainment of the desired uniform deposit of metal upon the cylinder.

The effect of rotation of the cylinder through the electrolyte in the tank or receptacle is to lower the level of the liquid at the right of Figure 6, and to slightly raise the level at the left of said figure. It will be observed, referring to Figure 1, that the opening leading into the auxiliary receptacle 26 is located at the part of the tank or receptacle in which the level of the liquid is raised by normal rotation of the cylinder therethrough. The liquid thus discharged from the gap between the poles is caused to flow through the opening 67 so that the liquid that has just passed through the gap is directed toward the filter.

The electrolyte accordingly that has passed through the gap between the poles is thus caused to flow toward the filter due to the normal rotation of the cylinder, and the flow of electrolyte through the filter is continuously assured by the operation of the pump 68, which serves to withdraw electrolyte from the receptacle and return it adjacent the bottom of the main tank. The circulation thus caused by the rotation of the cylinder and by the action of the pump serves to maintain the electrolyte in continuous agitation so that the uniform character thereof is insured at all times.

When the electroplating action has continued so as to form a deposit of the order of 0.006 inch, a coating sufficient for the purpose of receiving an etching for use in rotogravure or similar printing, the cylinder is removed from the receptacle which may be readily accomplished by simply raising the cylinder out of the open boxes 48, in which the bearings rest. The bolts 45 that hold the member 43 in clamping engagement with the shaft sections are then released and the sleeve carrying the current collector 46 and the gear 47 for driving the cylinder respectively are thus simultaneously removed from the cylinder, and said sleeves are applied to the shaft sections of the next cylinder that is to be plated, the application of such sleeves to the new cylinder serving to assemble with respect to such new cylinder the current collector just referred to. The new cylinder may then simply be inserted in the tank by again positioning the bearings 39 in the open boxes 48, the current collector again contacting with the bush 59 and the gear 47 meshing with the pinion 50. Rotation of the cylinder can be started immediately so that the electroplating action is not initiated until after the cylinder is in rotation. This ensures the formation of the desired uniform thin coating or shell upon the cylinder when the bars 32 supported in the cradle have been approximately consumed to one-half of their weight due to the continuance of the electroplating action. Preferably the cradle is then lined with new bars of metal, and the partially consumed bars are super-posed upon the new bars and the electroplating action then continued with the result that the partially consumed bars are eventually completely consumed in the electroplating action.

It will thus be seen that an electric pole is provided that may generally follow the contours of the cylinder to be plated, though said pole consists essentially of a multiplicity of bars of

metal of uniform width and thickness, and of the desired length, which bars may be obtained upon the market at low cost. If cylinders of varying sizes are electroplated as is customary in practice, the rotation of the shaft 51 carrying the driving pinion 50 may be varied so that the surface speed of the cylinder to the electrolyte is equal to 600 or 800 feet per minute. If cylinders of varying sizes are to be plated, preferably, a cradle having a supporting surface that parallels the surfaces of the immersed cylinder is employed, though it has been found that where the variation in cylinders is not great, that the same cradle may be used in successfully electroplating printing cylinders of varying diameter.

The invention may be embodied in other specific forms without departing from the spirit or essential characteristics thereof. The present embodiment is therefore to be considered in all respects as illustrative and not restrictive, the scope of the invention being indicated by the appended claims rather than by the foregoing description, and all changes which come within the meaning and range of equivalency of the claims are therefore intended to be embraced therein.

What is claimed and desired to be secured by United States Letters Patent is:—

1. In electroplating apparatus comprising a receptacle for electrolyte, a rotatable cylinder constituting one of the electric poles, a stationary pole approximately paralleling the part of the cylinder normally immersed in the electrolyte and terminating close to the surface thereof so that the rotation of the cylinder causes the initiation of a circulation of the electrolyte from between said poles over the edge of said pole, and means to continue the circulation of the electrolyte discharged over said edge.

2. In electroplating apparatus comprising a receptacle for electrolyte, a rotatable cylinder constituting one of the electric poles, a stationary pole approximately paralleling the part of the cylinder normally immersed in the electrolyte and terminating close to the surface thereof so that the rotation of the cylinder causes the initiation of the circulation of the electrolyte from between said poles over the edge of said pole and a filter arranged to receive the electrolyte circulated by said cylinder.

3. In electroplating apparatus comprising a receptacle for electrolyte, a rotatable cylinder constituting one of the electric poles, a stationary pole approximately paralleling the part of the cylinder normally immersed in the electrolyte and terminating close to the surface thereof so that the rotation of the cylinder causes the initiation of a circulation of the electrolyte from between said poles over the edge of said pole, and a filter to receive said electrolyte circulating over the edge of said pole and pumping means to purify and continue the circulation of said electrolyte respectively.

4. In electroplating apparatus comprising a receptacle for electrolyte, a supplementary receptacle in communication with said electrolyte receptacle so that the electrolyte will flow into the supplementary receptacle, purifying means in said supplementary receptacle, a movable electric pole to assist the circulation of electrolyte from said first to said second named receptacle through said purifying means and pump means to return the electrolyte to said first named receptacle.

5. In electroplating apparatus comprising a receptacle for electrolyte, a supplementary receptacle in communication with said electrolyte re-

ceptacle so that the electrolyte will flow into the supplementary receptacle, purifying means in said supplementary receptacle, a movable electric pole to assist the circulation of electrolyte from said first to said second named receptacle through said purifying means and pump means to return the electrolyte to said first named receptacle so as to cause agitation of the electrolyte there-within.

6. In electroplating apparatus comprising a tank for the electrolyte, a cylinder having shaft sections projecting from opposite ends, sleeves clamped to said shaft sections and carrying bearings, open bearing boxes supported by said tank and receiving said bearings, a gear on one of said sleeves, a current collector on one or both of said sleeves, a driven pinion arranged adjacent said tank for meshing engagement with said gear when said bearings are positioned in said boxes, a stationary pole in said tank, and an electric circuit through said current collector and stationary pole.

7. In electroplating machine comprising a tank, for the electrolyte, a rotatable pole, mechanism to operate said pole, a filter adjacent said tank disposed so that rotation of said pole causes electrolyte to flow to said filter and means to return the electrolyte from the filter to the tank.

8. A cylinder electroplating apparatus comprising

a tank, a cylinder rotatably mounted in said tank, a stationary pole approximately paralleling less than one half of the cylinder surface, a supplementary tank including filtering means arranged so that the electrolyte will flow therein when said cylinder is rotated, and pump means to return the electrolyte from the supplementary tank to the main tank beneath said stationary pole.

9. The combination defined in claim 8 in which said stationary pole consists of a support and a multiplicity of bars arranged flatwise side by side on said support.

10. In electroplating apparatus comprising a tank for the electrolyte, a cylinder having shaft sections projecting from opposite ends, sleeves clamped to said shaft sections and carrying bearings, notches formed in opposite walls of said tank to accommodate said shaft sections, a lining for said tank, said lining being formed to cover said notches and to provide housings for said sleeves, open bearing boxes supported by said tank and receiving said bearings, a gear on one of said sleeves, and a driven pinion arranged adjacent said tank for meshing engagement with said gear when said bearings are positioned in said boxes.

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