Oct. 18, 1938. J. M. HOSDOWICH 2,133,324

BARREL PLATING APPARATUS

Filed June 24, 1935 2 Sheets-Sheet 1

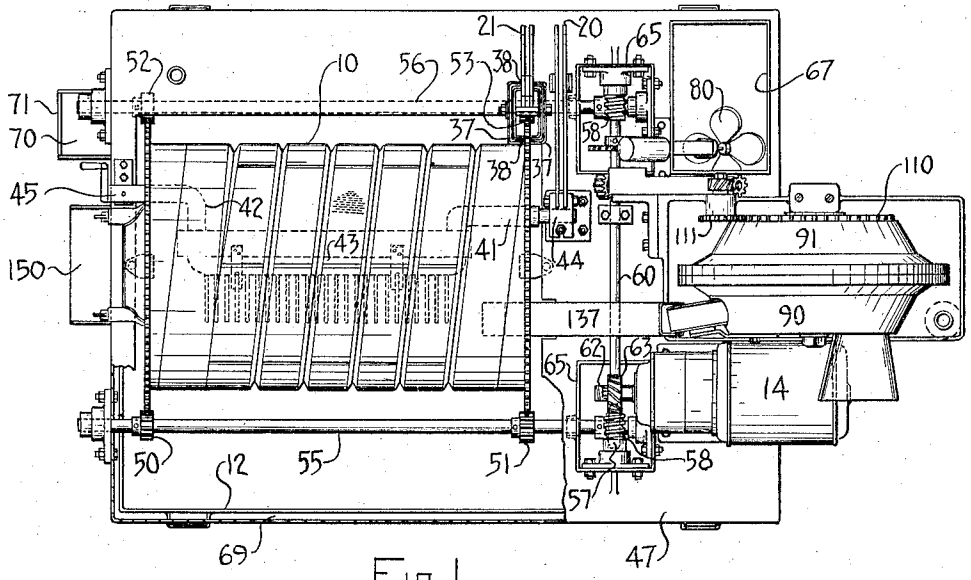


Fig. 1

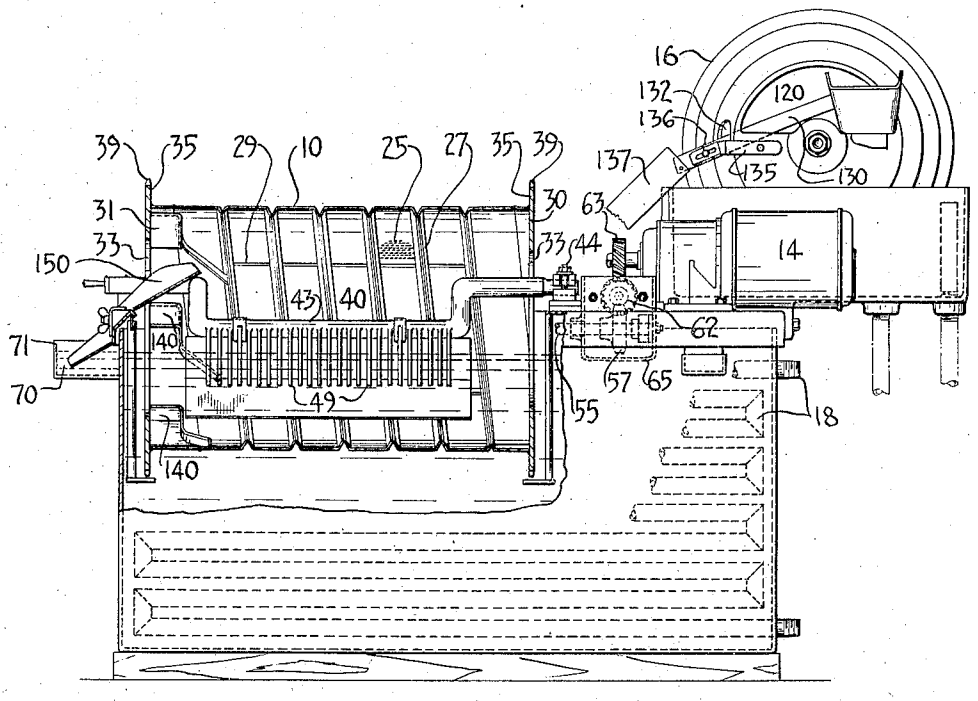


Fig. 2

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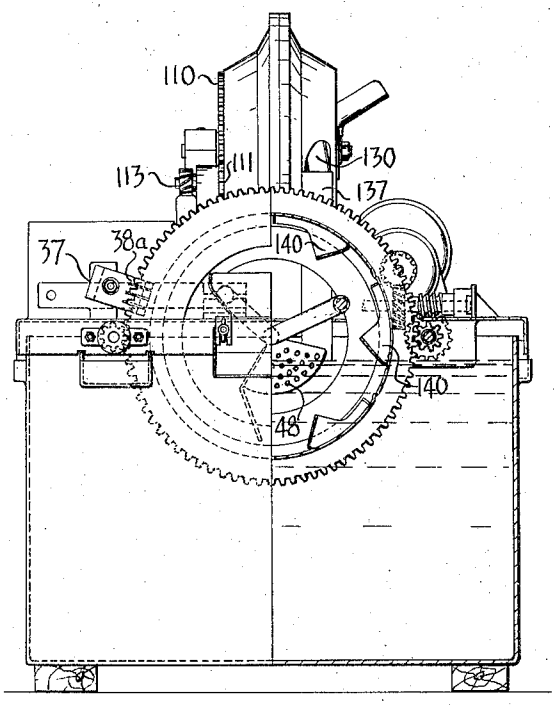


Fig. 3

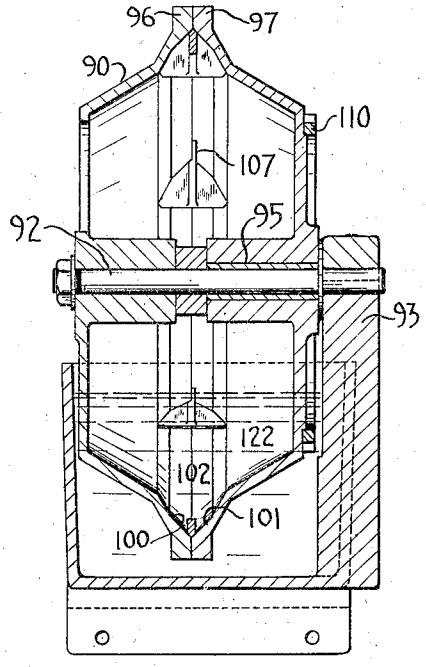


Fig. 5

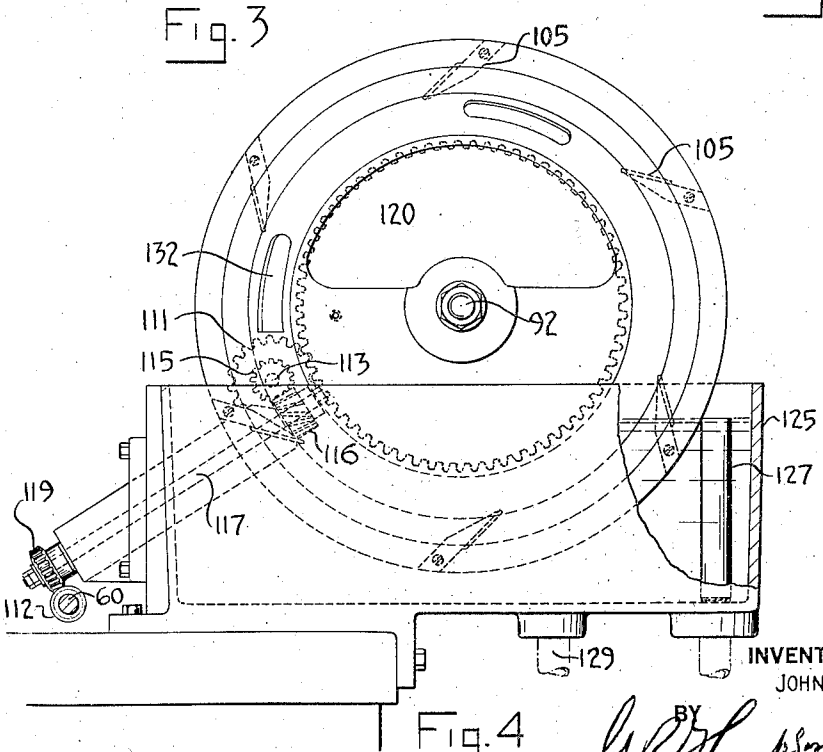


Fig. 4

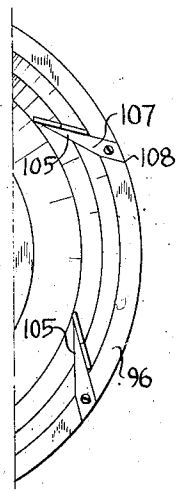


Fig. 6

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2,133,324

BARREL PLATING APPARATUS

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Application June 24, 1935, Serial No. 28,064

12 Claims. (Cl. 204—11)

This invention relates to barrel plating apparatus and provides improvements therein.

Chromium plating in barrels is a matter to which much thought and attention has been given ever since chromium-plating became a practical art. The conditions for successful chromium plating in barrels are considerably more exacting than for ordinary tank plating. The principles for such successful chromium plating in barrels are set forth in the patent to Fink and Eash 1,899,679, dated February 28, 1933.

The present invention provides improvements in the barrel-plating apparatus in the direction (*a*) of enabling the process of plating in barrels to be carried out on varieties of articles within a comparatively wide range, and on mixtures of articles of different shape and size, with only minor adjustments such as are readily made on the current and voltage and on the temperature; (*b*) of providing for varying the rate of feed of articles to the barrel so that a rate of feed best suited to the plating of the kind of article to be plated may be obtained; (*c*) of providing a good and reliable current distribution within the apparatus and solution; (*d*) of providing a uniform temperature of the solution within the apparatus and particularly within the barrel at the vicinity of the articles being plated; (*e*) of enabling the process to be carried on virtually with the elimination of rejects; (*f*) of keeping the barrel actuating parts to a large extent, and especially the bearings out of the plating solution; and (*g*) of simplifying the apparatus and providing for ready and easy access to and assembling and dis-assembling of the parts of the apparatus.

An embodiment of the invention is illustrated in the accompanying drawings, wherein:

Fig. 1 is a top plan view of the apparatus, with parts broken away;

Fig. 2 is a view partly in side elevation and partly in vertical section of the part shown in Fig. 1;

Fig. 3 is a view partly in end elevation and partly in transverse vertical section;

Fig. 4 is a view in side elevation of the part of the mechanism for feeding articles to the barrel;

Fig. 5 is a transverse section of the parts shown in Fig. 4.

Fig. 6 is a fragmentary view, looking toward the inside face, of the rotating part of the feeding device shown in Figs. 4 and 5.

Referring to said drawings, numeral **10** designates a plating barrel; **12** designates a tank for containing a plating solution as a chromic acid-acid radical plating solution, in which the barrel is partly immersed; **14** designates a motor for rotating the barrel **10** through means hereinafter described; **16** designates a suitable means for feeding articles to be plated to the tank; **18** designates a means, as a coil, through which a medium for regulating the temperature of the plating solution in the tank may be circulated; and **20** and **21** designate respectively electrical leads to the anode and barrel (cathodic).

The barrel **10** is conducting is preferably perforated as indicated at **25**, though it can also be made without perforations, and is constructed and operated in such a manner that the contents are intermittently tumbled while continuously immersed, as described in the patent to Fink and Eash 1,899,679 hereinbefore referred to. The barrel is rotated at a slow rate (as for example ½ revolution per minute). The barrel **10** is provided on its inside with a spiral rib **27** which acts to advance or feed the work, as the barrel is rotated, from its intake end (at the right in Figs. 1 and 2) to its discharge end (the left in said figures). The rib **27** is preferably made of electrically insulating material highly resistant to the action of the chromic acid solution, the use of such a rib showing an exceptional saving in the current used as compared with a conducting rib. The material which is used for the rib is a conjoint polymerization product of two different vinyl compounds, as described in the application of George K. Herzog, Serial No. 753,827, filed November 20, 1934. Means **29** such as cleats or corrugations may be provided on the inner surface of the barrel to aid in accomplishing a periodical or intermittent tumbling action of the articles within the rotating barrel during the plating operation which is carried on therein. The barrel is preferably made with end pieces **30**, **31**, having large central openings therein as indicated at **33**. The end pieces **30**, **31** are preferably of a greater diameter than the barrel, and have portions **35** which extend outwardly beyond the diameter of the barrel. The portions **35** provide annular conducting rings extending edgewise from the axis of the barrel, with which brushes **37**, connected with the cathode leads **21**, make sliding contact, and thereby conduct current to the barrel while it is being rotated.

To obtain a highly uniform conductance from the cathode lead **21** to the barrel, the brushes **37** are each formed of a plurality of superposed thin copper plates the ends of which are turned inward, so that the end of each plate bears on the terminal of the cathode lead **21** and on the por-

tion 35 of the end-pieces 30 respectively as indicated at 38. The superposed plates are slotted, as indicated at 38a, to provide fingers. The division of the brushes 37 provided by the superposed plates and by the slots through the superposed plates, provides a uniform area of contact between the brushes and the part 35 of the moving barrel. One brush 37 is provided on each side of the part 35, and the pair of brushes are pressed against the terminal of the cathode lead 21 and the portion 35 of the barrel by means passing through each brush intermediate its ends, as a bolt and nut shown at 38b. The currents which the brushes are required to transmit for chromium plating are unusually heavy and the arrangement described has been specially designed to transmit such heavy currents, and in a way to avoid arcing and fluctuation and also in a way to avoid the generation of sufficient heat to dry the chromic acid plating solution which comes in contact therewith, such drying would cause sparking at the brushes, with consequent pitting of the part 37 with which the brushes contact, and fluctuation of the current. Gear teeth 39 are preferably cut on the portions 35 of the end plates 30, 31 so that these end plates may function as gear wheels through which the barrel is rotated, as hereinafter more fully described.

40 designates an anode, of a material such as usually used with chromic acid plating baths, which is constructed and arranged so as to be supported independently of the barrel, and also in such manner as to be removable through the openings 33 in the end pieces of the barrel. The anode comprises a bar 43, the ends of which are preferably offset and raised as indicated at 41 and 42. The ends 41, 42 of the anode pass through the openings 33 in the end plates 30, 31 adjacent the inner edges thereof, and rest on bearings 44, 45, one of which, as the bearing 44, may be a terminal-clamp, to which the anode leads 30 are connected, and through which current is conducted from the anode. The bearings or clamps 44, 45, are outside of the barrel, and support the ends 41, 42 of the anode rotatably, so that when the barrel is not in use the anode may be readily turned so to lift the unused parts out of the solution. The bearings 44, 45 are preferably supported upon a cover 47 which partially covers the top of the tank 12. The ends of the anode are out of the plating solution and also out of the spray which arises from the solution within the tank, and the offset arms 41, 42, passing out through the openings close to the inner edges of the end-pieces 30, 31 afford maximum clearance through the said openings 33 for the introduction and removal of articles to and from the barrel. The anode 40 also preferably comprises a plurality of spaced transverse discs or plates 49, which project from the bar 43 below the surface level of the plating solution in the tank. The discs are preferably perforated, as indicated at 48 to increase the anode-area. The number of the discs and the perforations therein thereby provide a large area of contact between the solution and the anode.

The barrel 10 is preferably rotatably supported in such manner as to be readily removable from the apparatus. To this end, it is preferably supported by a plurality of rotating parts 50, 51, 52, 53, above the solution level within the tank. The parts 50 to 53 are preferably in the form of pinions which engage the teeth 39 on the end pieces 30, 31. The pinions 50–53 are preferably arranged substantially in line with the horizontal diameter of the barrel, at opposite sides of the barrel. The axis of the barrel is thereby well above the solution level of the tank. The openings 33 in the end pieces extend below the solution level, the greater part of the area of the openings however being above the solution level of the tank. In this way the solution level is made so high that the barrel, during its rotation, does not lift the articles on its inner circumference, high enough to carry them out of the solution before they tumble back into the low part of the barrel. The pinions 50–53 are preferably fixed on shafts 55 running lengthwise of the tank alongside of the outer sides of the barrel above the solution level of the tank. The barrel may be removed, (after the anode 40 has been disengaged), by simply shifting it sideways and lifting it upwardly, to disengage the pinions from teeth 39 on the end pieces 30, 31, and thereby release the barrel. The shafts 55, 56, may be rotatably connected with the motor through worm wheels 57, worms 58 on opposite ends of a cross shaft 60, a worm 62 on the cross shaft, and a worm 63 on the shaft of motor 14. Boxes 65 project downwardly through the tank cover 47 and surround and protect the worms on shafts 55 and 60, and also the bearings of these shafts, from the solution and spray within the tank. Chromic acid plating solution oxidizes lubricating oils, and is itself an anti-lubricant. The boxes act to prevent the solution coming into contact with the bearings, worms and gears. These boxes also act as receptacles for preventing lubricant from the bearings, worms and gears falling into the plating solution.

Numeral 67 designates a collar on the tank cover 47, on which collar a flue may be connected, through which fumes and spray arising from the surface of the solution within the tank may be drawn off. The cover 47 is spaced from the sides of the tank as indicated at 69, and air entering through the space 69 is drawn across the upper part of the tank below the cover 47 and carries fumes and spray with it through the suction duct connected to the collar 67.

A cup 70 which extends outwardly from the side of the tank, and communicates with the space within the tank, may be provided. The cup 70 is preferably provided with a lip 71, over which the solution within the tank may flow. This lip 71 serves to regulate the solution level within the tank, and in practice the tank is kept filled to this level.

Numeral 80 designates a stirrer. This stirrer is located within the tank in such position as to create a circulation of the plating solution out of the end nearest the stirrer and in the other end. In practice it is found highly desirable to maintain the solution at a uniform temperature. In practice the temperature is regulated within a variation of ±2° C. In barrel plating in which a conducting barrel is used, and particularly in chromium plating where relatively high current densities are employed, a comparatively large amount of heat is generated in the solution within the barrel. It is accordingly important to provide a positive circulation of the plating solution to and from the barrel. Such a circulation is provided by the described arrangement. The stirrer provides a circulation of the solution at a very even temperature in at one end of the cylinder and out at the other. In a barrel which is perforated, the perforations 25 admit the solution along the length of the

barrel, particularly at the bottom side of the barrel where the plating current is concentrated.

High effectiveness of plating is favored by regulating the rate of feed of articles to the barrel, the rate of feed being regulated on the basis of trial and experience, in accordance with the size and shape of the articles to be plated in the barrel. The feeding means 16 is constructed and arranged to provide for such a variation in the rate of feed of the articles.

The feeding mechanism 16 comprises a pair of hollow frustums 90, 91 mounted on an axle 92 mounted on a bracket 93. One of the frustums, as the frustum 90, is fixed upon the said axle 92, and the other is rotatable upon said axle as indicated at 95. The rim portions 96, 97 of the two frustums are fitted together very closely, so that the least amount of space is left between the two rim portions, and the entrance of very small articles, or of thin parts of articles, between said rim portions is minimized. The parts of the two frustums adjacent the rim portions are formed with steep sides 100, 101 so as to form an annular groove or pocket 102. Within the annular pocket 102 are arranged a plurality of scoops 105. These scoops 105 are shaped to the sides of the annular pocket or groove 102. The scoops 105 have tangs 107 which fit into grooves 108 mortised into the sides of the rim 96 of the stationary disc 90. The scoops 105 are removable. By varying the number of scoops 105 in use (by removing one or more), and by varying the size of the scoops, the rate of feed of articles from the feeding mechanism may be varied without having to change gears. The frustums and scoops are made of rustless material so as not to speck the work or contaminate the plating bath. Aluminum and stainless steel have been used.

The rotatable hollow frustum 91 is conveniently rotated at a regular speed, related to the speed of rotation of the barrel 10, by a suitable means. These means, as here shown, comprise a gear wheel 110 fixed to the hollow frustum 91, a pinion 11 on a stub-shaft 113 having thereon a worm 115 meshing with another worm 116 on a shaft 117, which latter shaft has thereon a gear 119 meshing with a worm 112 on the aforesaid cross-shaft 60 which drives the shafts 55 and 56 which carry the pinions for rotating the barrel 10.

Numeral 120 designates an opening in the side of the hollow frustum 90 through which articles to be fed to the barrel and plated, are placed in the feeding mechanism, and a mass of these articles is maintained in the space 122 within and between the hollow frustums 90, 91, which part of the feeding mechanism may be designated as a hopper.

It has been found to contribute to successful plating to keep the articles wet, after they have been cleaned and placed within the hopper 122, until they are fed to the barrel. For this purpose a trough 125 is provided, which trough is provided with an overflow pipe 127, and kept filled to the level of the top of the overflow pipe by liquid (water) which is constantly supplied to the trough 125 through supply pipe 129. The hollow frustums 90 and 91 extend below the surface of the liquid in the trough 125 to such an extent that the hopper portion 122 is below the level of the liquid in the trough 125.

A chute 130 projects into the upper part of the space between the hollow frustums 90, 91 through a suitable opening 132. The chute 130 is adjustable longitudinally within the said space between the hollow frustums 90, 91. For this purpose the chute 130 may be attached to a slotted arm 135 to which it may be fastened by means of a stud and clamp screw 136 which is adjustable in the slot in said arm 135. The chute 130 may also be turned on the stud 136 to adjust the position of its receiving-end with relation to the dumping-position of the scoops 105.

The chute 130 connects with another chute 137 which extends into the barrel 10 through the opening 33 at the front end, and delivers the articles to be plated to the front end of the barrel. The chute 130, like the frustums, is made of rustless material.

The scoops 105 attached to the rotatable frustums 91 pick up a certain number of the articles from the hopper or space 122 between the hollow discs 90, 91, at the lower part thereof, and lift these upwardly as the aforesaid frustum 91 rotates. When the scoops reach their upper position or thereabouts, the articles which have been carried up and retained by the scoops are dumped into the chute 130, and from thence slide down the chutes 130 and 137 into the barrel at its front end. As heretofore explained the rate of feed of the articles may be varied by varying the number of scoops 105 in use, and also the size of the scoops. The rate of feed may be further varied by adjusting the upper end of the chute 130 toward and from the dumping position of the scoops 105; by a rotative adjustment around the stud 136; and by a combined longitudinal and rotative adjustment. By removing the upper end of the chute 130 further from the dumping position or from the axis of the trajectory of the dumped articles, a less number of articles dumped from each of the scoops will be caught by the chute 130, and vice versa.

Articles dumped into the front end of the barrel 10 will be advanced beneath the anode 40 to the rear end of the barrel, by the spiral rib 27 as the barrel 10 rotates. The mass of articles lying in the bottom part of the cathodic barrel between each spiral of the rib 27 will be acted on by the current and plated, during which process the articles will be intermittently and repeatedly tumbled. When the plated articles reach the rear end of the barrel, they are caught in one or another of a plurality of pockets 140, and raised in these pockets as the barrel rotates. The pockets 140 are preferably insulated so as to be non-conducting. As the pockets reach the upper position within the barrel, the articles therein will be dumped, and as they are dumped they are caught by a chute 150 which projects into the barrel through the opening 33 in the end plate 31, the articles falling on the chute 150 being carried away, as to a wash tank and drying apparatus, as it is usual after articles are removed from a plating tank.

A description of the operation of the device has been combined with the description of the structure.

From the foregoing description it will be perceived that the invention provides a barrel plating apparatus in which all of the driving parts of the apparatus and the electrical connections are outside of the solution and to a large extent protected from the fumes and spray arising from chromium plating solutions; in which the anode and barrel may be removed and replaced with great ease of facility, in which considerable variation in the rate of feed of the articles to the plating barrel may be obtained without change of gears; and in which a rise in the temperature of

the solution within the barrel is effectively prevented and a uniform temperature of the solution in the immediate vicinity of the articles being plated effected, thereby, (and also by the feed regulation) contributing materially to the capability of plating varieties of articles within a comparatively wide range, and mixtures of articles of different kinds and shapes.

The invention may receive other embodiments than that herein specifically illustrated and described.

What is claimed is:

1. Barrel plating apparatus, especially applicable for chromium plating from the chromic acid type of plating solution, comprising a tank for containing the plating solution at a predetermined solution level therein, a rotatable metallic barrel with which articles therein make electrical contact, having end-pieces with large central openings through which objects may extend eccentrically into the barrel without meeting obstruction when the barrel is rotated, an anode within and extending longitudinally of said barrel, means comprising shafts and bearings for supporting said barrel at each side at or adjacent the sides of its horizontal axial plane, said horizontal axial plane being adjacent but above the solution level of the tank so that a large segment of the barrel may be immersed and said bearings are above said solution level.

2. Barrel plating apparatus according to claim 1 further including shields interposed between said bearings and the space above said solution, to protect said bearings from spray from said solution.

3. Barrel plating apparatus according to claim 1, further including an anode extending longitudinally within said barrel and having offset ends extending through the openings at each end of said barrel, said offset ends lying adjacent the edges of the end-pieces of the barrel, so as to leave the central part of the openings in said end-pieces clear.

4. Barrel plating apparatus according to claim 1, further including an anode extending longitudinally within said barrel and having offset ends extending through the openings at each end of said barrel, said offset ends lying adjacent the edges of the end-pieces of the barrel, so as to leave the central part of the openings in said end-pieces clear, said anode further comprising a large number of transverse segments extending below the solution level of the tank, so as to provide an exceptionally large anode area for oxidizing compounds reduced from chromic acid which are formed in the plating solution during plating.

5. Barrel plating apparatus according to claim 1, wherein said end pieces have portions extending outwardly beyond the diameter of the barrel, and further comprising brushes making electrical contact with said outwardly extending portions of the end-pieces.

6. Barrel plating apparatus according to claim 1, wherein said end pieces have portions extending outwardly beyond the diameter of the barrel, and further comprising brushes making electrical contact with said outwardly extending portions of the end-pieces, said brushes being of a size and area to reduce heating to such extent as not to dry the solution on the brushes scraped from the end-pieces during rotation of the barrel.

7. Barrel plating apparatus according to claim 1, wherein said end-pieces have gear-teeth thereon, and wherein said means for supporting the barrel comprises shafts and gears thereon engaging the gear-teeth on said end-pieces at two sides of the barrel.

8. Barrel plating apparatus according to claim 1, further comprising a cover extending over the top of said tank and spaced from the tank at the sides, and wherein the bearings of said means for supporting the barrel are mounted on said cover at parts thereof out of communication with the air-space above the solution.

9. Barrel plating apparatus according to claim 1, further comprising a cover extending over the top of said tank and spaced from the tank at the sides, and wherein the bearings of said means for supporting the barrel are mounted on said cover at parts thereof out of communication with the air-space above the solution, and means for drawing outside air through said space between the tank and cover.

10. Barrel plating apparatus according to claim 1, further including a stirrer in the tank, so arranged as to produce a circulation in and out of the ends of the barrel.

11. Barrel plating apparatus according to claim 1, further including a spiral rib on the inner side of the barrel for advancing articles lengthwise of the barrel, said rib being of electrically insulating material, inert toward a chromic acid plating solution.

12. Barrel plating apparatus according to claim 1, further comprising a spiral rib and a pocket at the delivery end of said rib, said rib and pocket being on the inner face of said barrel, said rib acting to advance articles lengthwise of the barrel, and said pocket receiving said articles advanced by the rib and lifting them to a dumping position adjacent the top side of the barrel, said rib and pocket being electrically insulated.

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